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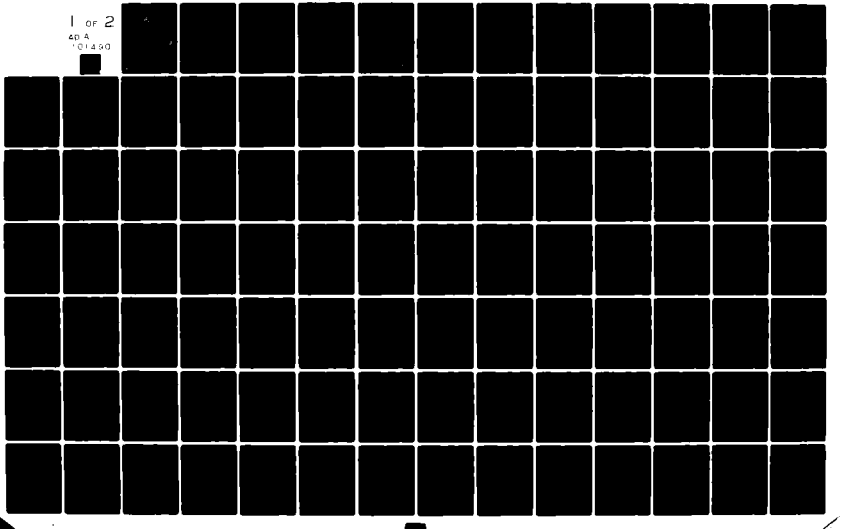

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A TOOL FOR DETECTING PLAGIARISM IN PASCAL PROGRAMS

by

Samuel L. Grier, Jr.

B.S., USAF Academy, 1973

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirements for the degree of

Master of Science

Department of Computer Science

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This Thesis for the Master of Science Degree by

Samuel L. Grier, Jr.

has been approved for the

Department of

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Grier, Samuel L., Jr. (M.S., Computer Science)
A Tool for Detecting Plagiarism in Pascal Programs
Thesis directed by Professor Lloyd D. Fosdick

Plagiarism has become a problem in introductory Computer Science courses. Programmed assignments can be copied and transformed with little human effort. A pertinent recommendation has resulted from this realization: an on-line system to detect programs that are "too similar" and hence suspected of plagiarism should be developed [5]. The purpose of this thesis has been to construct such a system in the form of Program Accuse.

Program Accuse analyzes Pascal programs to detect those pairs of programs such that plagiarism is a possibility.

An overriding concern of the development of Accuse has been that it be inexpensive to use. In addition, the use of Accuse is intended for introductory Computer Science courses. The result is a program that is efficient, but limited in its ability to detect sophisticated plagiarism. Efficiency means low cost; lack of comprehensive analysis is rationalized with the assumption that the student clever enough to plagiarize with sophistication has no need to plagiarize.

Accuse measures 20 parameters in each program: for example, total lines in the program, variables

declared and not used, and the number of control statements. Seven of these parameters were chosen through testing as a means to compute a correlation number that determines if two programs are similar.

If two programs are considered similar, they are flagged for the user to inspect and make the judgement as to whether plagiarism occurred.

Signed Lloyd D. Fosdick
Faculty member in charge of thesis

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

Plagiarism has become a problem in introductory Computer Science courses. Programmed assignments can be copied and transformed with little human effort. A pertinent recommendation has resulted from this realization: an on-line system to detect programs that are "too similar" and hence suspected of plagiarism should be developed [5]. The purpose of this thesis has been to construct such a system in the form of Program Accuse.

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CHAPTER II

BACKGROUND

An attempt to construct such an on-line system has been made at Purdue University by K.J. Ottenstein [4]. He developed a program that quantifies the sameness of Fortran programs using the four basic Software Science parameters suggested by M. Halstead as useful measures of program length [3]. These parameters are: (1) the number of unique operators, (2) the number of unique operands, (3) the total number of occurrences of operators, and (4) the total number of occurrences of operands. It seems the first suggestion to use these parameters as measures of similarity or dissimilarity (depending on your viewpoint) came from N. Bulut as a by-product of his study of invariant properties of algorithms [1].

M. Halstead developed the notion of Software Science in 1972. He advances the four parameters above as properties of any computer program that are capable of being counted or measured. He defines these parameters and their relationships as follows [3]:

n1 = number of unique operators

n2 = number of unique operands

N1 = total number of operators

N2 = total number of operands

vocabulary n = n1 + n2

length N = N1 + N2

He also provides data to support the following relationship [3]:

$$N = n1 \log n1 + n2 \log n2$$

Ottenstein's program utilizes only the four basic Software Science parameters, and it counts them in a straightforward manner. He acknowledges his program detects only cosmetic changes: reordering time independent statements, recommenting, reformatting of text, and renaming variables and labels. He believes that plagiarism can be deterred both by the knowledge of the existence of a program like his and its ability to make it reasonably difficult to cheat successfully [4].

Ottenstein uses the length N to categorize his input programs. Those that have identical N1, N2, n1, and n2 counts are then suspected of plagiarism [4].

Inherent in M. Halstead's theories is the assumption that programs are well-written and polished. For example, in almost all cases for which the length indicator (N) was tested, the programs had been prepared for publication [2].

M. Halstead recognized that not all programs would be well-written, and hence derived and defined six classes of impurities as follows [3]:

(1) complementary operations: the successive application of two complementary operators to the same operand

example: R := T * T + T - T

(2) ambiguous operands: the same operand name is used to represent two or more variables within a program

example: R := P + Q; R := R * R

(3) synonymous operands: using two operand names to represent the same variable within a program

example: T1 := P + Q; T2 := P + Q; R := T1 + T2

(4) common subexpressions: the same subexpression occurs more than one time within a program

example: R := (P*Q) + (P*Q)

(5) unwarranted assignment: an expression is assigned to a temporary operand that is used only once

example: T := P + Q; R := T;

(6) unfactored expressions: the same operators and operands repeat in an expression (making the expression difficult to understand)

example: R := P * P + 2 * P * Q + Q * Q

Fitzsimmons and Love conjecture that a compiler can detect all of these impurities [2], and only (6) above cannot be mechanically corrected [3]. Any system that attempts to detect plagiarism can expect to encounter these impurities.

CHAPTER III

DESIGN OF ACCUSE

Two principle ideas guided the development of Accuse: (1) that Accuse be as inexpensive to use as possible, and (2) that the individual able enough to plagiarize cleverly has no need to plagiarize.

When construction of Accuse was being planned, the idea of using the front end of a compiler as the driver was considered. There were several reasons for this: (1) the desire to use as much shelf material as possible, and (2) the lack of awareness of Software Science for this particular application.

After the discovery of Ottenstein's attempt and his method, it was felt that a counter could be written that would be faster than even a stripped down compiler. However, because Accuse is not a compiler, it needs to be used in the context of a larger tool that retrieves programs, compiles them and saves their output for graders, and then sends them to a file for processing by Accuse.

The result of not using a compiler is a compromise between speed and comprehensive analysis. Accuse processes over 170 lines per second. However, as noted above, it will not discover changes made by the sophisticated plagiarist. Again, this is rationalized with

the assumption that the student intelligent enough to plagiarize with sophistication has no need to plagiarize.

Accuse was designed top-down, but implemented from the bottom up. Each module was developed as needed; for while we knew the main components of the system, it was impossible to predict the support routines. A module's ability to achieve the desired counts was certified before construction of the next module.

Program Accuse was constructed with the belief that additional parameters are available beyond the four basic Software Science parameters, and that heuristics can be employed to achieve more than detection of cosmetic changes. Using these heuristics and seven parameters, Accuse computes a correlation number that is used to determine the similarity of two programs.

Accuse measures 20 parameters. The seven that comprise the correlation number were selected by testing different combinations of them.

Accuse measures the following 20 parameters (for full definitions see Appendix A):

1. total lines
2. code lines
3. code comment lines
4. multiple statement lines
5. constants and types
6. variables declared (and used)

7. variables declared (and not used)
8. procedures and functions
9. var parameters
10. value parameters
11. procedure variables (includes 9 and 10)
12. for statements
13. repeat statements
14. while statements
15. goto statements
16. unique operators
17. unique operands
18. total operators
19. total operands
20. indenting function

The seven parameters that comprise the correlation number are:

1. unique operators
2. unique operands
3. total operators
4. total operands
5. code lines
6. variables declared (and used)
7. total control statements

While being constructed, it was believed that an "indenting function" would play an important role in the detection of plagiarism. Since Computer Science 210

students use cards and do not have access to the sophisticated editing features of a time sharing terminal, it was thought that changes to the style of a copied program would be clumsy at best. This resulted in the rejection of any sophisticated indenting functions and the selection of a simple one. The function currently counts the number of left, right, and unindented lines of code. The indenting function is created as follows:

```
indenting function =

( (left indentations) mod 1000) * 1000000 +
 (right indentations) mod 1000) * 1000 +
  (zero indentations) mod 1000)
```

The results have proved disappointing. If all of the input programs were processed through a "pretty printer," an indenting function might become important. This additional cost is presently considered prohibitive, and it is contrary to the intent of Accuse being inexpensive to use. The unimportance of an identing function necessitated the search for an alternate parameter that would reflect some characteristic of the lines of a program. The result was the idea to count lines of executable code in a program, and the results of this decision are thus far promising.

The decision to introduce the use of heuristics in the way counts are made in Accuse was two-fold: (1) to make plagiarism difficult to achieve, and (2) to make Accuse's repeated use feasible in light of the fact that

its use will quickly become common knowledge. The heuristics are simple and straightforward.

"Total operators" does not include assignment operators. In addition, for every assignment operator found, two operands are subtracted from "total operands," and "code lines" is decremented. The purpose of this is to prevent Accuse from being misled by unnecessary initializations and unnecessary assignment statements. This desire roughly correlates to the prevention of M. Halstead's fifth defined impurity, "unwarranted assignments."

"Code lines" ignores blank lines, comment lines, and declarations. It counts only the lines of executable code within a program. This is intended to prevent excess declarations and comments from affecting this parameter's value.

Accuse is also selective about what it calls operators. A "BEGIN END" combination and "()" combination are considered operators in Software Science. Because BEGINs, ENDs, and parentheses can be added to Pascal code where not required, Accuse chooses to ignore them. A semicolon is ignored for essentially the same reason. IF is considered an operator while THEN is not. ELSE is considered an operator because it is not a necessary part of an IF statement.

As Accuse only counts variables, the obvious tactic of changing variable names makes no difference to Accuse. Since Pascal requires declarations, Accuse can keep track of variables declared and subsequently used or not used. Hence, declaring extra variables and then not using them does not affect Accuse's analysis. Constants of enumerated types and tag fields in case clauses of record declarations that contain a declaration are considered variables. Since these constants cannot be read or written, their nonuse is considered notable.

CHAPTER IV

SHORTCOMINGS

Accuse has three main drawbacks. The first is that it is unable to detect five of the impurities defined by Halstead. This may in fact not be that critical; for any system to detect and then "undo" any impurities once found would at the least be expensive; in addition, the individual we wish to catch plagiarizing is not likely to introduce these impurities.

The second is that because the input program is not parsed, but is guided by a driver that expects a compilable program, syntactically incorrect programs may be accepted by Accuse. Accuse uses a modified Pascal scanner, specifically the Pascal-J scanner made available to students at the University of Colorado for graduate work. Hence it detects some syntax errors: for example, incorrect literal strings and comments that lack their left part. However, it may very well accept syntactically incorrect programs.

The final drawback is that since the current policy in conjunction with the use of Accuse does not include the user making the students' "graded runs," there is nothing to prevent a student from changing or sabotaging his program before he submits it for processing

by Accuse. The cost of rerunning all students' programs is presently considered prohibitive, and checking every student's final listing against an unordered listing of 150 programs is impractical.

The first drawback is not a detriment if grading enforces a policy that does not allow these impurities by exacting a severe penalty for their use.

The second and third are resolved if Accuse is used in the context of a larger tool.

CHAPTER V

OUTPUT

Accuse prints four results for the user. The first is a dump of each program's identifier and its values of the 20 parameters measured by Accuse. This dump is sorted on the "indenting function."

The second result is a dump of each program's identifier and its respective values of the seven parameters used to compute the correlation number; each parameter list is sorted smallest to largest. In the output, the column headed FOR STMT actually contains the total number of control statements. This is the result of the implementation of summing parameters.

The third result is a frequency distribution graph that indicates the number of pairs of programs with like correlation numbers. A new addition to the listings is the Tukey estimate for suspicion of plagiarism.

The final result is a list of all pairs of programs with correlation number greater than or equal to 28. Twenty-nine is currently identified as the number that indicates the possibility of plagiarism, with 32 the maximum correlation number possible.

CHAPTER VI

DEFINING THE CORRELATION SCHEME

The scheme that computes the correlation number is only a tentative one. The current scheme was developed and tuned by using a group of 43 programs from an introductory course. Code for three of the programs was written together, but finished individually. The "importance" values for the seven correlation parameters were then adjusted until these three programs were brought into the domain of "those programs suspected of plagiarism."

The current correlation scheme involves computing an increment for each pair of affected programs based on the equation

increment = "importance" - (pcounta - pcountb)

where pcounta and pcountb represent parameter counts and (pcounta - pcountb) is less than or equal to some "window" size depending on the particular parameter.

The computation of the correlation number may well be subject to improvement by a more elaborate scheme or by simple changes to the importance factors.

Five runs of Accuse follow the text of this paper. The first run (Appendix B) processed 13 programs, three of which were input twice. Included in this run is a

printout of the triangular matrix that contains correlation values of the pairs of programs. This matrix is not printed in a production model of Accuse.

Below we illustrate the computation of the correlation number for a pair of programs in the first run. Before proceeding, it is necessary to note the following "window" sizes and "importance" factors for each of the correlation parameters:

1. total operators
   window size = 5
   importance factor = 6

2. total operands
   window size = 5
   importance factor = 6

3. unique operators
   window size = 3
   importance factor = 5

4. unique operands
   window size = 3
   importance factor = 5

5. code lines
   window size = 3
   importance factor = 5

6. declared variables (and used)
   window size = 2
   importance factor = 3

7. control statements
   window size = 1
   importance factor = 2

The correlation number for the pair of programs T102 and T107 (see Appendix B, p. 32) is computed as follows:

1. T107 - T102 = 8
   Eight is greater than the window size for this parameter, hence these are not "affected" programs.

2. T107 - T102 = 16
   Again, these are not "affected" programs.

3. T107 - T102 = 1
   These programs are now within the window size, and an increment is calculated for this pair of programs:
   increment = 5 - (25 - 24) = 4
   correlation number = 4

4. T102 - T107 = 0
   increment = 5 - (13 - 13) = 5
   correlation number = 9

5. T102 - T107 = 1
   increment = 5 - (64 - 63) = 4
   correlation number = 13

6. T107 - T102 = 0
   increment = 3 - (11 - 11) = 3
   correlation number = 16

7. T102 - T107 = 0
   increment = 2 - (4 - 4) = 2
   correlation number = 18

The second listing (Appendix C) is a production run of Accuse. There were 137 input programs consisting of 13,374 lines of code. Accuse processed the code on a CDC machine at a cost of $12.32. It required:

FL TO LOAD 110700	FL TO RUN 77100
89.956 CP SECS	105237B CM USED

The maximum number of asterisks printed in the distribution graph is 40; hence the "flat" distribution.

Accuse prints all pairs of programs with correlation number greater than or equal to 28, though 29 is the number that indicates the possibility of plagiarism.

CHAPTER VII

ANALYSIS OF RESULTS

Effectiveness

A question that arises is, "What are the chances that two programs will be declared similar when they have been independently written?" A similar question is, "How many programs can Accuse accept before so many programs are suspected of plagiarism that Accuse's results become unacceptable?"

These questions are not addressed by Ottenstein. He analyzes his findings and concludes that the way he categorizes the input programs results in a somewhat normal distribution, in agreement with our intuition. He makes the observation that if two programs are suspected of being similar (because they have the same N value), the odds that they are similar are greater if the correlation number occurs at one of the extreme values of N. He concludes that any correlation function that one could derive that produces a constant distribution would not be accurate or necessarily desirable because, in general, meaningful measurements of human behavior produce uneven distributions [4].

I see two aspects to these questions. The first addresses the size of the problem being solved. A

problem that takes only 12 lines of code to solve will certainly result in a different answer to these questions than if we consider a problem that takes 100 lines of code to solve. The second considers how many parameters are used to compute the correlation number.

One interesting result of the current data available from Accuse has been that the less code a student writes into a given program, the more even the distribution of the parameters appears to be. Note the third listing (Appendix D). In this assignment students were responsible for approximately 14 lines of code; the rest was given to the student. Ignoring the anomolies, we compute the differences between the minimum and maximum values:

TOTAL OPERS	TOTAL OPNDS	UNIQ OPERS	UNIQ OPNDS	CODE LINES	DECL VARS	CONT STMTS
19	20	4	8	18	8	2

These compressed ranges imply the occurrences of higher correlation numbers since the correlation numbers are computed using the proximity of values. The frequency distribution graph tells us nine pairs of programs have a correlation number of 28 or higher.

If we go back to the second listing (Appendix C) and again, ignoring anomolies, note the differences between the maximum and minimum values:

TOTAL OPERS	TOTAL OPNDS	UNIQ OPERS	UNIQ OPNDS	CODE LINES	DECL VARS	CONT STMTS
48	55	12	11	49	6	4

These larger ranges imply the occurrences of lower correlation numbers. The frequency distribution graph tells us six pairs of programs have a correlation number of 28 or higher.

These observations appeal to our intuition. The wider the ranges, the lower the correlation numbers, and vice versa.

Another attractive conjecture is that the more input programs, the higher the correlation numbers generated. In our examples above, our expectation is incorrect. The first set of data where nine pairs of programs correlate at 28 or higher inputs 43 programs. The second inputs 137 programs, and only six pairs of programs correlate at 28 or higher.

We make three assertions: (1) that a simple and short program is going to generate more pairs of programs with high correlation numbers than will a more difficult and longer program when both generate the same number of pairs of programs, (2) that the number of programs that Accuse can accept before its results are unacceptable is a function of both the number of input programs and the complexity and length of those programs, and (3) that the more independent correlation parameters, the lower the correlation numbers.

The first two have already been argued. The third can be argued as follows: let us consider the seven

correlation parameters as independent events; for each parameter, one can calculate a theoretical probability that two programs will have the same value; multiplying these seven probabilities together will give the theoretical probability that two programs will have the same value for every parameter; removing any of the given parameters will clearly increase this product, hence increasing the likelihood of two programs having a maximum correlation number.

When Plagiarism Occurs

Available data supports the selection of 29 as the number that suggests plagiarism. This choice was made through observation, and is by no means absolute.

The interesting point of analyzing our data is that we can look at it from two different aspects. The first is as above, where we viewed the results in terms of the individual parameters. Bulut makes the statement that the probability of using n1 and n2 exactly N1 and N2 times in two different algorithms is very slim [1]. Both our results and Ottenstein's results verify his assertion.

The second way to view our results comes from the manner in which we categorize or "fingerprint" the input programs. Ottenstein uses N to categorize his input programs, and it is the distribution that N creates that Ottenstein analyzes. We categorize our programs using a correlation number, and if we analyze the distribution

created by our correlation numbers, we come to somewhat the same conclusions.

First, the correlation numbers create a somewhat normal distribution, though they appear not to fit any "standard" distributions [7].

Second, by the way we have built our correlation scheme, two programs are declared similar only if the correlation number occurs at an extreme value of the distribution. In Ottenstein's categorization, two programs can be declared similar in the center of his distribution. Hopefully, then, our correlation scheme is better.

Finally, since the distribution created by our correlation scheme is not a uniform one, it is likely to be an accurate measurement of human behavior [4].

Looking at the data from this viewpoint, it would be nice to have a verification of our selection of 29 as a choice for the number that suggests plagiarism. J.W. Tukey suggests a way to analyze distributions that fit no standard distributions [6]. This analysis fits well with our desire.

He suggests taking two "hinges," one each at the midpoints between the outer edges and the median of the distribution (these hinges correspond to the quartiles). He defines one and one half times the difference between the values that occur at these points as a "step."

Finally, any values that occur beyond the value at these hinges plus two steps (called the "outerfences") are considered unreasonable.

For a hypothetical example, then, if the lower hinge occurs at 14 and the upper hinge at 17, our outerfence occurs at

$$17 + 2 * (1.5*(17-14)) = 26$$

and any correlation number greater than 26 is considered unreasonable; or, in our application, considered plagiarism.

Accuse has been altered to compute this value; test results, though inconclusive, are encouraging. Though the fourth listing (Appendix E) provided gives a number of 27 as being the outerfence (hence 28 implies plagiarism), it is easy to see that there are no programs that are beyond the outerfence. One can conclude that in this case, 29 is as good a guess as the computed 28.

Computing the probability that two programs would have the same value for a given parameter was discussed earlier. This computation could lead to supplying the user with some additional information that will help him in his judgement as to whether or not plagiarism has occurred. If we look at the fourth listing, we can make some observations.

First, let us make the assumption that for each range of values for a given parameter, each value has an

equal likelihood of occurring. Second, let us arbitrarily throw away the largest and smallest values of each parameter. Then, for each range of values observed, we can calculate the number of expected pairs of programs with equal values for that given parameter. Let us begin with TOTAL OPERS. Range = 151 - 67 + 1 = 85. Any two programs written independently will be assumed to have a total operator count of between 67 and 151, and the probability of them having any one of the possible values is 1/85 * 1/85 = 1/7225. The probability of their having any of the possible values over the entire range is 1/7225 + 1/7225 + . . . + 1/7225 = 1/85. Given that there are 31 input programs, and hence (31 * 30)/2 = 465 pairs of programs, one can expect 5.5, or approximately six pairs of programs to have equal values. We observe four. Following this through, we can calculate expected versus observed pairs for every parameter:

TOTAL OPERS
expected = 465/85 = 5.5 = 6
observed = 4

TOTAL OPNDS
expected = 465/62 = 7.5 = 8
observed = 11

UNIQ OPERS
expected = 465/7 = 66.4 = 67
observed = 73

UNIQ OPNDS
expected = 465/24 = 19.4 = 20
observed = 24

```
CODE LINES
expected = 465/45 = 10.3 = 11
observed =                 19

DECL VARS
expected = 465/24 = 18.6 = 19
observed =                 21

FOR STMTS
expected = 465/6 = 77.5 = 78
observed =               104
```

From the results, it appears not to be unreasonable to assume that all values are equally likely. A statistician, then, can calculate these values and make a judgement as to whether it appears that plagiarism occurred for any parameter. Doing this for every parameter would allow one to conjecture if plagiarism occurred over all parameters and hence over an entire program. Coming up with some final probability that plagiarism occurred for the input programs would contribute to the successful use of Accuse.

Side Issues

One of the most revealing aspects of this research has been the often enormous variations in the measured parameters. It is incredible to think that two programs as analyzed by Accuse could possibly solve the same problem. This gives rise to a suggested alternate use of Accuse.

Accuse, modified appropriately, could measure the "goodness" of a program. Its analysis could identify both excesses (for example, the programmer used an excessive

number of variables) and shortcomings (for example, the programmer used few comments). Accuse is also capable of identifying variables declared and not used. This information could allow a grader to make a quantitative analysis of any program at a glance and grade the program accordingly.

CHAPTER VIII

CONCLUSION

The sabotaged programs given as input to Accuse show that it cannot stand alone as a detector of plagiarism, but must in fact be part of a larger system. This system should be one that retrieves the student's program, compiles it, runs it on data the student has never seen, and then sends the student's program into a file that will eventually be processed through Accuse.

Accuse accomplished its goal of being inexpensive to use. Results were actually better than expected.

Finally, Accuse needs to be put into production use to verify or reject assertions made here.

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APPENDIX A

DEFINITION OF PARAMETERS

1. **total lines:** total lines in a program.
2. **code lines:** lines of executable code within a program.
3. **code comment lines:** lines of comments (excluding declarations) in a program.
4. **multiple statement lines:** lines of executable code that contain more than one statement.
5. **constants and types:** number of type and constant declarations.
6. **variables declared (and used):** variables declared and subsequently used in a program.
7. **variables declared (and not used):** variables declared and subsequently not used in a program.
8. **procedures and functions:** number of procedures and functions declared in a program.
9. **var parameters:** *number of var parameters declared and subsequently used in* a program.
10. **value parameters:** number of parameters declared and subsequently used in a program.
11. **procedure variables:** number of variables declared (including 9 and 10 above) and subsequently used in a program.
12. **for statements:** number of for statements in a program.
13. **repeat statements:** number of repeat statements in a program.
14. **while statements:** number of while statements in a program.
15. **goto statements:** number of goto statements in a program.

16. unique operators: number of different operators in a program; presently included are: ABS, AND, ARCCOS, ARCSIN, ARCTAN, ARCTAN2, CARD, CASE, CHR, CLOCK, COS, COSH, DATE, DISPOSE, DIV, ELSE, EOF, EOFS, EOLN, EOLNS, EOS, EOSS, EXP, EXPO, FOR, GENSORT, GET, GETSEG, GETRAN, GETRANDOM, GOTO, HALT, HIGH, IF, IN, LINELIMIT, LOG, LOG10, LOW, LN, MESSAGE, MOD, NEW, NOT, OCT, ODD, OR, ORD, PACK, PAGE, POWER, POWERI, PRED, PUT, PUTSEG, RAN, RANDOM, READ, READLN, REGISTERS, RELEASE, REPEAT, RESET, REWRITE, ROUND, SETRAN, SETRANDOM, SKIPBLANKS, SIN, SINH, SQR, SQRT, SUCC, TAN, TANH, TIME, TRUNC, UNPACK, UNDEFINED, WHILE, WITH, WRITE, WRITELN, "+", "-", "*", "/", "=", ",", ";", ".", "[", ":=", "<", ">", "<>", "<=", ">=", "^.", and "^".

17. unique operands: number of different numbers and variables used in a program.

18. total operators: total number of occurrences of the items in 16.

19. total operands: total number of occurrences of the items in 17.

20. indenting function: ((left indentations) mod 1000) * 1000000 +
(right indentations) mod 1000) * 1000 +
(zero indentations) mod 1000)

APPENDIX B

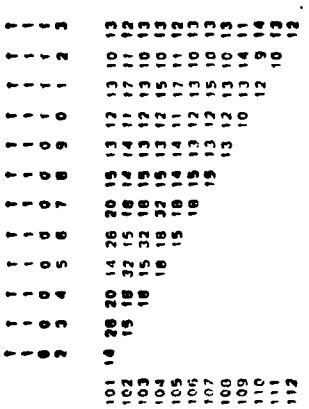
FIRST LISTING

TOTAL LINES	CODE LINES	COMMT LINES	CODE LINES	WHILE STMT TYPES	CONS AND TYPES	DECL VARS	VARS PROCS NOT USED	AND FUNCS	VAR PARAM	VAR PARAM	EPOC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIO OPERS	UNIO OPNDS	TOTAL OPERS	TOTAL OPNDS	
1110	161	48	48	0	3	12	0	2	3	2	8	0	0	5	0	25	14	90	68	
1113	168	72	39	0	3	12	0	2	3	2	8	0	0	4	0	25	14	156	126	
1106	158	58	63	0	3	11	0	2	3	2	8	0	0	4	0	25	13	115	96	
1103	158	58	63	0	3	11	0	2	3	2	8	0	0	4	0	25	13	115	96	
1112	125	71	43	0	3	10	0	2	3	2	6	0	0	4	0	24	12	100	73	
1111	174	66	60	0	3	11	0	2	3	2	8	0	0	3	0	24	14	134	117	
1109	189	44	70	0	3	11	0	2	3	2	8	0	0	4	0	24	13	97	81	
1101	178	56	64	0	3	11	0	2	3	2	8	0	0	4	0	25	13	117	98	
1108	226	79	80	0	3	11	0	2	3	2	8	0	0	4	0	25	13	103	159	
1102	200	64	75	0	3	11	0	2	3	2	8	0	0	4	0	24	13	110	90	
1105	200	64	75	0	3	11	0	2	3	2	8	0	0	4	0	24	13	110	90	
1104	189	53	78	0	3	11	0	2	3	2	8	0	0	4	0	25	13	118	106	
1107	189	63	78	0	3	11	0	2	3	2	8	0	0	4	0	25	13	118	106	

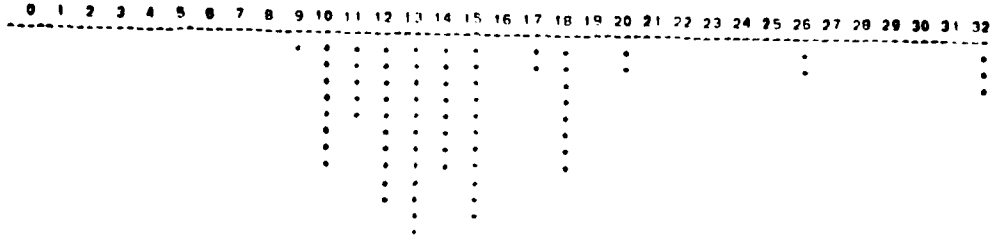
* VARIABLE(S) WERE DECLARED BUT NOT USED
** PROCEDURE(S) WERE DEFINED BUT NOT USED
*** VARIABLE(S) AND PROCEDURE(S) WERE DECLARED BUT NOT USED

TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR STMTS	
T110	90	T110	68	T102	24	T112	12	T109	44	T112	10	T109	3
T109	97	T112	73	T105	24	T107	13	T110	48	T102	11	T106	4
T112	100	T109	81	T111	24	T108	13	T101	56	T107	11	T101	4
T105	110	T102	90	T112	24	T103	13	T108	58	T105	11	T113	4
T102	110	T105	90	T109	24	T101	13	T103	58	T108	11	T103	4
T103	115	T108	98	T104	25	T106	13	T104	63	T111	11	T104	4
T106	115	T103	98	T108	25	T109	13	T107	63	T101	11	T107	4
T101	117	T101	98	T113	25	T105	13	T102	64	T109	11	T102	4
T104	118	T107	108	T107	25	T104	13	T105	64	T106	11	T105	4
T107	118	T104	106	T106	25	T102	13	T111	66	T104	11	T111	4
T111	134	T111	117	T110	25	T110	14	T112	71	T103	11	T108	4
T113	156	T113	136	T101	25	T113	14	T113	72	T113	12	T110	5
T108	183	T100	159	T103	25	T111	14	T108	79	T110	12	T112	7

WARNING: HEADING(S) ARE NOT CORRECT. AT LEAST ONE REFLECTS A SUM OF TWO COUNTS.



FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS



THE FOLLOWING PAIRS HAVE A CORRELATION OF 32:
T102,T105
T103,T106
T104,T107

APPENDIX C

SECOND LISTING

TOTAL LINES	CODE LINES	CODE COMNT LINES	MULT STMT LINES	CONS AND TYPES	DECL VARS	VARS NOT USED	PROCS AND FUNCS	VAR PARAM	VAL PARAM	PROC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIQ OPERS	UNIQ OPERS	TOTAL OPERS	TOTAL OPNDS	INTERFACING
0064	70	49	8	0	5	0	0	0	0	0	5	0	1	0	20	12	63	57	54
0083	70	30	10	0	8	0	0	0	0	0	5	0	1	0	21	14	54	46	[illegible]
0075	103	36	24	0	8	0	0	0	0	0	4	0	1	0	22	11	62	56	[illegible]
0050	73	41	2	0	7	0	0	0	0	0	4	0	1	0	21	12	56	46	[illegible]
0014	103	44	16	0	7	0	0	0	0	0	4	0	1	0	22	13	62	50	[illegible]
0118	59	36	11	0	7	0	0	0	0	0	5	0	1	0	21	12	55	43	[illegible]
0037	100	58	16	0	10	0	0	0	0	0	4	0	0	0	19	16	90	39	[illegible]
0067	36	20	4	1	5	0	0	0	0	0	2	0	0	0	10	10	31	31	[illegible]
0042	80	29	16	0	8	0	0	0	0	0	5	0	1	0	23	12	65	61	[illegible]
0055	98	43	22	0	7	0	0	0	0	0	5	0	1	0	22	12	67	50	[illegible]
0079	69	40	22	0	8	0	0	0	0	0	4	0	1	0	21	12	54	46	[illegible]
0005	78	43	11	0	7	0	0	0	0	0	2	0	1	0	20	14	60	48	[illegible]
0011	104	41	18	0	7	0	0	0	0	0	5	0	1	0	22	10	61	51	[illegible]
0013	83	43	13	0	7	0	0	0	0	0	5	0	1	0	23	15	73	70	[illegible]
0043	83	48	15	0	7	0	0	0	0	0	5	0	1	0	25	13	75	68	[illegible]
0053	92	51	17	0	7	0	0	0	0	0	5	0	1	0	22	11	68	59	[illegible]
0103	87	54	23	0	11	0	0	0	0	0	4	0	1	0	22	18	62	60	[illegible]
0027	85	37	32	0	7	0	0	0	0	0	4	0	1	0	22	15	64	55	[illegible]
0064	88	36	16	0	8	0	0	0	0	0	5	0	1	0	21	12	59	49	[illegible]
0051	84	35	10	0	8	0	0	0	0	0	4	0	1	0	23	15	67	58	[illegible]
0033	93	46	18	0	5	0	0	0	0	0	5	0	1	0	21	13	62	55	[illegible]
0012	120	42	17	0	11	0	0	0	0	0	5	0	1	0	19	16	50	44	[illegible]
0046	90	50	19	0	7	0	0	0	0	0	5	0	1	0	21	12	64	56	[illegible]
0059	90	45	21	0	8	0	0	0	0	0	5	0	1	0	23	13	64	55	[illegible]
0072	85	50	18	0	5	0	0	0	0	0	3	0	1	0	19	8	61	57	[illegible]
0078	108	52	18	0	10	0	0	0	0	0	6	0	1	0	22	14	58	51	[illegible]
0107	90	56	13	0	9	0	0	0	0	0	4	0	2	0	18	13	55	52	[illegible]
0001	96	60	15	0	8	0	0	0	0	0	5	0	1	0	20	12	64	55	[illegible]
0100	119	61	22	0	8	0	0	0	0	0	6	0	1	0	22	13	93	92	[illegible]
0031	109	55	15	0	8	0	0	0	0	0	5	0	1	0	22	14	60	55	[illegible]
0096	74	61	6	0	7	0	0	0	0	0	5	0	1	0	21	15	81	63	[illegible]
0092	128	59	17	0	11	0	0	0	0	0	5	0	1	0	23	15	86	74	[illegible]
0006	117	73	17	0	10	0	0	0	0	0	5	0	1	0	22	17	92	81	[illegible]
0068	91	39	14	0	7	0	0	0	0	0	4	0	1	0	24	13	55	47	[illegible]
0102	91	41	16	0	8	0	0	0	0	0	5	0	1	0	22	15	57	57	[illegible]
0081	63	37	8	0	8	0	0	0	0	0	6	0	1	0	20	13	45	49	[illegible]
0019	78	39	13	0	10	0	0	0	0	0	5	0	1	0	19	16	48	44	[illegible]
2218	83	43	12	0	7	0	0	0	0	0	2	0	1	0	21	9	57	45	[illegible]
0010	78	44	15	0	8	0	0	0	0	0	5	0	1	0	20	13	57	46	[illegible]
0079	102	45	15	0	8	0	0	0	0	0	4	0	1	0	20	13	60	55	[illegible]
0114	116	46	11	0	8	0	0	0	0	0	5	0	1	0	22	15	65	63	[illegible]
0023	114	51	25	0	8	0	0	0	0	0	5	0	1	0	24	10	68	67	[illegible]
0105	90	57	18	0	7	0	0	0	0	0	5	0	1	0	21	12	64	46	[illegible]
0070	118	61	11	0	9	0	0	0	0	0	7	0	1	0	21	14	78	65	[illegible]
0047	104	45	15	0	8	0	0	0	0	0	5	0	1	0	20	15	59	50	[illegible]
0064	83	54	14	0	8	0	0	0	0	0	5	0	1	0	20	12	79	75	[illegible]
0037	74	36	3	0	8	0	0	0	0	0	5	0	1	0	25	9	54	45	[illegible]
0017	87	44	14	0	8	0	0	0	0	0	4	0	1	0	19	12	57	46	[illegible]
0067	83	48	3	0	8	0	0	0	0	0	5	0	1	0	21	11	61	56	[illegible]
0041	98	58	17	0	8	0	0	0	0	0	5	0	1	0	20	9	68	53	[illegible]

	TOTAL LINES	CODE LINES	CODE COMMT LINES	MULT STMT LINES	CONS AND TYPES	DECL VARS	VARS NOT USED	PROCS AND FUNCS	VAR PARAM	VAL PARAM	PROC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIQ OPERS	UNIQ OPNDS	TOTAL OPERS	TOTAL OPNDS	INTERFACING FUNCTION
DD87	81	42	23	0	0	5	0	0	0	0	0	3	0	2	0	23	12	59	50	[illegible]
DD85	103	44	19	0	0	8	0	0	0	0	0	4	0	1	0	21	12	57	50	[illegible]
AY70	81	47	14	0	0	8	0	0	0	0	0	5	0	1	0	21	14	81	60	[illegible]
GD18	101	67	4	0	0	0	0	0	0	0	0	6	0	1	0	21	15	87	79	[illegible]
1418	74	39	13	0	0	8	0	0	0	0	0	5	0	1	0	22	12	61	53	[illegible]
DD84	78	40	12	0	4	8	0	0	0	0	0	5	0	1	0	23	11	78	63	[illegible]
DD21	109	54	28	0	0	8	0	0	0	0	0	5	0	1	0	19	16	65	62	[illegible]
UD09	118	39	28	0	2	6	0	0	0	0	0	5	0	1	0	22	9	56	46	[illegible]
DC09	101	44	14	0	3	7	0	0	0	0	0	5	0	1	0	20	11	61	60	[illegible]
C145	103	52	33	0	0	8	0	0	0	0	0	5	0	1	0	23	13	77	72	[illegible]
DD18	92	64	4	0	0	10	0	0	0	0	0	2	0	3	0	22	16	78	65	[illegible]
DD03	113	44	34	0	0	7	0	0	0	0	0	5	0	1	0	21	16	87	79	[illegible]
DC45	100	54	27	0	0	9	0	0	0	0	0	7	0	1	0	23	10	80	74	[illegible]
DC45	93	54	9	0	2	10	0	0	0	0	0	6	0	1	0	22	13	58	50	[illegible]
AY46	119	48	44	0	0	9	0	0	0	0	0	6	0	1	0	21	14	70	62	[illegible]
E101	100	54	30	0	0	7	0	0	0	0	0	4	0	1	0	22	12	63	56	[illegible]
DD74	87	43	11	3	0	6	0	0	0	0	0	4	0	1	0	21	12	58	49	[illegible]
DC74	81	48	9	0	2	5	0	0	0	0	0	5	0	1	0	20	11	59	51	[illegible]
DC41	100	51	21	0	0	5	0	0	0	0	0	3	1	2	0	21	10	79	70	[illegible]
DD83	122	97	0	0	0	9	0	0	0	0	0	6	0	2	0	23	14	107	81	[illegible]
DM77	88	62	10	6	0	9	0	0	0	0	0	2	3	0	0	23	15	73	68	[illegible]
AR28	103	70	11	0	0	9	0	0	0	0	0	8	0	1	0	25	15	90	78	[illegible]
DC65	135	50	24	0	12	8	0	0	0	0	0	4	0	1	0	21	11	69	67	[illegible]
DC92	131	89	9	0	0	8	0	0	0	0	0	4	0	3	0	20	13	112	111	[illegible]
DD53	84	51	13	0	1	10	0	0	0	0	0	5	0	1	0	18	17	58	51	[illegible]
DC38	71	42	29	0	4	7	0	0	0	0	0	5	0	1	0	21	10	61	54	[illegible]
D191	90	60	7	0	0	9	0	0	0	0	0	6	0	1	0	24	18	83	74	[illegible]
DD52	112	60	15	0	3	8	1	0	0	0	0	8	0	1	0	20	11	63	59	[illegible]
DC87	140	63	27	0	0	11	0	0	0	0	0	5	0	1	0	19	16	71	59	[illegible]
L693	104	69	9	0	3	7	0	0	0	0	0	6	0	1	0	24	11	78	65	[illegible]
DD16	99	52	18	0	2	5	0	0	0	0	0	5	0	4	0	25	9	90	73	[illegible]
DD68	96	49	15	1	3	10	0	0	0	0	0	4	0	1	0	23	14	78	71	[illegible]
DC09	96	69	14	0	0	8	0	0	0	0	0	5	0	1	0	18	13	66	49	[illegible]
S104	87	57	11	0	4	11	0	0	0	0	0	2	0	3	0	22	17	69	66	[illegible]
DD07	105	46	24	0	3	8	0	0	0	0	0	7	0	1	0	23	9	69	66	[illegible]
D175	104	57	34	0	0	8	0	0	0	0	0	5	0	1	0	20	14	65	53	[illegible]
AW19	136	39	45	0	0	8	0	0	0	0	0	5	0	1	0	22	13	58	46	[illegible]
DC49	81	55	17	0	0	7	0	0	0	0	0	6	0	1	0	24	14	75	63	[illegible]
AW48	91	45	22	1	0	7	0	0	0	0	0	5	0	1	0	22	16	62	60	[illegible]
DD72	87	50	10	0	2	7	0	0	0	0	0	5	0	2	0	23	10	68	56	[illegible]
DC06	97	52	22	0	3	7	0	0	0	0	0	5	0	1	0	24	12	64	59	[illegible]
DD77	103	51	39	0	0	8	0	0	0	0	0	5	0	1	0	24	15	68	61	[illegible]
CF02	85	51	9	0	0	9	0	0	0	0	0	5	0	2	0	23	15	63	58	[illegible]
D189	149	90	10	0	0	9	0	0	0	0	0	7	0	1	0	21	14	93	81	[illegible]
DC51	70	50	16	0	0	8	0	0	0	0	0	5	0	1	0	20	14	58	52	[illegible]
DC45	113	62	17	0	2	7	0	0	0	0	0	4	0	2	0	18	10	65	57	[illegible]
E102	95	66	27	1	2	8	0	0	0	0	0	5	0	1	0	21	15	69	57	[illegible]
DJ74	78	41	22	0	0	7	0	0	0	0	0	5	0	1	0	23	14	67	61	[illegible]
DJ75	93	58	25	0	0	8	0	0	0	0	0	7	0	1	0	24	13	77	71	[illegible]
DM67	74	40	7	0	0	8	0	0	0	0	0	5	0	1	0	23	11	59	48	[illegible]

	TOTAL LINES	CODE LINES	CODE COMNT LINES	MULT STMT LINES	CONS AND TYPES	DECL VARS	VARS NOT USED	PROCS AND FUNCS	VAR PARAM	VAL PARAM	PROC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIQ OPERS	UNIQ OPNDS	TOTAL OPERS	TOTAL OPNDS	PROGRAM DESCRIPTION
DCA6	116	73	58	0	3	7	0	0	0	0	0	3	1	3	0	24	12	89	78	
DD11	113	53	8	0	0	9	0	0	0	0	0	5	0	1	0	24	15	78	78	
DD13	133	72	40	0	0	6	0	0	0	0	0	6	0	1	0	22	14	88	88	
DH22	74	42	2	0	0	7	2	0	0	0	0	6	0	1	0	21	13	55	49	*
DC55	108	43	17	0	0	7	0	0	0	0	0	3	0	1	0	21	15	82	88	
DDG6	118	62	15	0	6	6	0	0	0	0	0	5	0	1	0	22	10	72	66	
DH17	97	42	32	0	0	8	0	0	0	0	0	4	0	1	0	23	14	55	46	
DD18	83	51	21	0	0	7	0	0	0	0	0	5	0	1	0	20	14	49	37	
DC19	77	46	19	0	5	6	0	0	0	0	0	5	0	1	0	19	10	60	48	
DC14	118	58	48	0	0	7	0	0	0	0	0	5	0	1	0	23	12	81	63	
DD78	64	33	9	0	2	9	0	0	0	0	0	4	0	1	0	21	14	56	46	
DC89	81	41	8	0	0	7	0	0	0	0	0	5	0	1	0	21	12	51	37	
DD20	101	81	28	0	2	10	0	0	0	0	0	5	1	1	0	28	16	86	84	
DC29	108	78	15	0	2	8	0	0	0	0	0	6	2	1	0	26	11	79	60	
DD22	108	54	10	0	3	7	0	0	0	0	0	6	0	1	0	21	10	67	58	
ZP28	175	90	43	0	5	8	0	0	0	0	0	2	3	1	0	24	16	123	110	
CL20	153	51	42	0	3	6	0	0	0	0	0	5	0	1	0	25	9	78	71	
DC19	110	54	8	0	0	7	0	0	0	0	0	2	1	0	0	23	14	62	50	
DD38	165	88	39	0	2	5	0	0	0	0	0	11	0	1	0	24	16	121	121	
V131	57	45	3	0	2	5	0	0	0	0	0	5	0	1	0	19	10	58	49	
DD81	68	43	20	0	0	7	0	0	0	0	0	5	0	1	0	23	13	61	55	
DD31	78	44	15	0	0	6	0	0	0	0	0	5	0	1	0	20	12	70	52	
NE37	103	46	13	0	3	7	0	0	0	0	0	4	0	1	0	21	11	54	48	
DD16	95	43	15	0	4	7	0	0	0	0	0	4	0	1	0	24	11	57	48	
CA25	107	50	24	0	3	7	0	0	0	0	0	5	0	1	0	21	14	62	62	
CP25	137	62	30	0	4	7	1	0	0	0	0	5	0	1	0	19	11	78	67	*
DC16	111	54	22	0	2	8	0	0	0	0	0	5	0	1	0	21	9	64	49	
DH25	79	51	5	0	0	8	0	0	0	0	0	4	0	2	0	16	13	55	44	
CS28	146	65	27	0	5	7	0	0	0	0	0	3	0	3	0	23	10	82	70	
DH42	84	54	6	0	2	11	0	0	0	0	0	5	0	1	0	21	17	58	47	
DD72	91	46	16	0	0	7	1	0	0	0	0	5	0	1	0	22	15	59	55	*
DD63	93	54	8	0	2	6	1	0	0	0	0	5	0	1	0	21	11	62	54	*
DD32	102	75	10	0	0	9	0	0	0	0	0	5	0	2	0	22	14	84	68	
DD33	105	82	16	0	1	10	1	0	0	0	0	4	0	1	0	17	17	64	52	*
DDH2	91	55	4	0	2	14	0	0	0	0	0	6	0	1	0	23	19	81	50	
DP96	171	82	31	0	2	7	0	0	0	0	0	5	0	1	0	21	11	81	68	
DC93	149	66	23	2	1	10	0	0	0	0	0	5	0	1	0	21	18	71	61	

* VARIABLE(S) WERE DECLARED BUT NOT USED
** PROCEDURE(S) WERE DECLARED BUT NOT USED
*** VARIABLE(S) AND PROCEDURE(S) WERE DECLARED BUT NOT USED

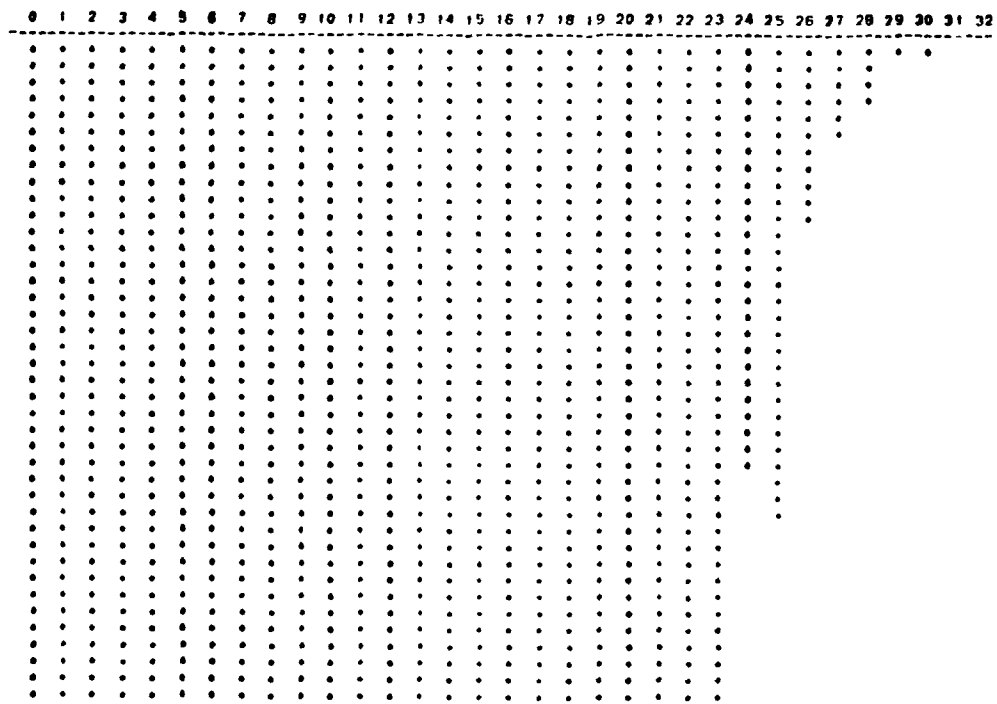
	TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR STMTS	
DC67	21	DC67	31	DC67	10	DC72	8	DC67	20	DC41	5	DC67	2	
DC81	45	DD46	37	DJ45	16	DD41	9	DC42	29	DD87	5	DC19	3	
DD39	48	DC89	37	DD33	17	DD37	9	DCB3	30	DC73	5	DC15	4	
DD48	49	DA47	39	DC45	18	DD16	9	DD76	33	V191	5	Z278	5	
DD12	50	DCB1	42	DD53	18	DC35	9	DD51	36	DC95	5	DM77	5	
DCB9	51	DJ48	43	DJ87	18	DC99	9	DJ48	36	DC74	5	DP18	5	
V191	52	DJ45	44	DC99	18	DD07	9	DC64	36	DD85	5	DD56	5	
DM99	54	DD19	44	V191	19	Z278	9	DD75	36	DP64	5	DD44	5	
DCB3	54	DD12	44	DC72	19	CC20	9	DD37	36	BM55	5	DD17	5	
DD37	54	DD37	45	DD21	19	DC41	10	DC81	37	DD67	5	DD76	5	
HIST	54	Z278	45	Y265	19	DC95	10	DD27	37	DC72	5	DD87	5	
DC68	55	DP18	46	DG35	19	CC36	10	DD19	39	DD16	6	DC65	5	
DM47	55	DD09	46	DA47	19	DD32	10	1418	39	DC47	5	E101	5	
D107	55	BW19	46	DC97	19	DE22	10	DD09	39	DD96	5	DM17	5	
D148	55	DD17	45	DD12	19	DC38	10	BW19	39	DD24	6	E104	5	
DJ45	55	DL95	46	DD37	19	DC81	10	DC68	39	DD41	6	DD75	5	
DK22	55	DD76	46	DD39	19	DC45	10	DD04	40	DD54	6	DM41	5	
DD58	56	DD58	46	DD52	20	V191	10	DM99	40	DC36	6	DM15	5	
DD09	56	DCB3	46	DP64	20	DD23	10	DM67	40	DDB3	6	DD58	5	
DU74	56	DM47	46	DD47	20	DG35	10	DCB9	41	DD17	6	HA47	5	
BW19	56	DLCB	47	DD61	20	DE66	10	DD58	41	DJ75	6	DU85	5	
DC51	56	DD62	47	DC51	20	DL53	11	DC91	41	DD61	6	E103	5	
DD53	56	HIST	48	DC75	20	DC38	11	DJ74	41	DD66	6	DD68	5	
DD76	56	DM67	48	DC74	20	DE53	11	DD12	42	DU07	6	DM99	5	
DD56	57	DG35	48	DD67	20	DC75	11	DK22	42	Z278	6	DDJ3	5	
C182	57	DM99	48	DD79	20	DD94	11	DC38	42	DD52	6	HIST	5	
DD85	57	DD56	48	DD01	20	DP06	11	DM47	42	DD77	6	DC68	5	
DD17	57	DD24	49	DM85	20	HIST	11	DU87	42	C145	6	DD27	5	
Z278	57	DC36	49	DC82	20	DC65	11	DC55	43	DM67	6	DD48	5	
DP18	57	DC64	49	DC81	20	CM17	11	DD13	43	DD09	6	DD74	5	
BM55	57	DK22	49	DP18	20	DC52	11	DD74	43	DG35	6	DC99	6	
DC79	58	V191	49	DD46	20	DE56	11	DD01	43	DD01	6	DC71	6	
DC85	58	DC19	49	DL98	20	DC74	11	BM55	43	1418	6	DD04	6	
DD52	58	DD14	50	DD18	21	DD67	11	DM85	43	DD23	6	DC98	6	
DC54	58	DD47	50	DC73	21	LC93	11	DC56	43	DD25	6	DD03	6	
DA47	58	DD75	50	DC71	21	DD52	11	Z278	43	CC20	6	BY48	6	
DD87	59	DD02	50	DM07	21	Y265	11	DP18	44	DD43	6	DU41	6	
DC32	59	DC49	50	DD63	21	U185	12	DD17	44	DE58	6	DP06	6	
DC74	59	DC95	50	DC38	21	DE51	12	DD14	44	DD37	6	Y265	6	
DD47	59	DD85	50	DJ89	21	DC66	12	DC98	44	DC92	7	DD13	6	
DM67	59	DP87	50	DC55	21	DP64	12	C182	44	DC14	7	E102	6	
DG35	60	BM55	50	C425	21	DC64	12	DD61	44	DC49	7	DC75	6	
DC71	60	DC91	51	BY46	21	DD05	12	DD85	44	DD46	7	Z026	6	
DM85	60	DC79	51	DD78	21	DE17	12	DD03	44	DE53	7	DD21	6	
DD79	60	DD53	51	AY70	21	DD58	12	DD29	45	DE22	7	DD43	6	
BY70	61	DC24	51	DD22	21	DH89	12	DC63	45	E101	7	DD39	6	
1418	61	DJ87	52	DC93	21	BM55	12	DD47	45	DC86	7	DC96	6	
DC98	61	DD33	52	DC41	21	DM99	12	BY48	45	DD05	7	DD11	6	
DC30	61	DD61	52	DC48	21	DD74	12	V191	45	BF72	7	DJ87	6	
DD81	61	DC51	52	DD03	21	DJ48	12	DCB4	46	DC43	7	DD08	6	

	TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR STMTS	
DC91	61	DC75	53	DC65	21	DD64	12	DG35	46	DC39	7	DN02	6	
DC72	61	T418	53	E102	21	E101	12	HIST	46	DC46	7	DD12	6	
DD82	61	DD41	53	DP06	21	DD87	12	DD07	46	CA25	7	DC97	6	
DD87	61	UC30	54	DD85	21	DC86	12	DC92	46	DK22	7	DC93	6	
BY48	62	DD63	54	DK22	21	D 42	12	DC73	46	DJ74	7	DD62	6	
DD44	62	DD27	55	DC83	21	T418	12	AY70	47	DC91	7	C182	8	
DD63	62	DC73	55	DC64	21	DC14	12	DC74	48	DC55	7	DC63	6	
CA25	62	DC71	55	DH99	21	DC46	12	DD67	48	C596	7	DD47	6	
DD75	62	DC92	55	DD62	21	DD01	12	BY46	48	DC38	7	DD79	6	
DC73	62	DD01	55	HIST	21	DP25	13	DC43	48	DC89	7	BW19	6	
DC49	62	DC63	55	Z278	21	DC99	13	DD68	49	DD27	7	DC51	6	
E103	62	DD81	55	DJ48	21	DD44	13	DP64	49	DC86	7	AY70	6	
E101	63	DD79	55	DC38	21	DD41	13	BP72	50	DJ48	7	DC64	6	
DD52	63	BP72	56	DD17	21	DJ75	13	DC72	50	DH99	7	DJ45	6	
CE62	63	DC46	56	DD05	21	DC63	13	DC51	50	DC68	7	DC83	6	
DP64	63	E101	56	DC89	21	BW19	13	DC65	50	L693	7	DC84	6	
DC36	64	DD67	56	DD58	21	DJ87	13	CA25	50	HIST	7	DC42	6	
DD33	64	DC72	57	DD74	21	DC81	13	DC46	50	DC45	7	DC49	6	
DC48	64	E102	57	DD76	21	DC42	13	DJ45	51	DC98	7	C145	6	
DC66	64	C182	57	BW55	21	DC85	13	CC20	51	DD03	7	DW67	6	
DD27	64	DL45	57	E103	22	DC68	13	DC41	51	BY48	7	DD09	6	
DD05	64	DP64	57	DP26	22	DP18	13	CE62	51	Y265	7	DD61	6	
DD01	64	DC53	58	DD43	22	DC73	13	DD23	51	DP06	7	DD68	6	
DC63	64	CE62	58	DD09	22	C145	13	DC53	51	DD44	7	DD77	6	
DC75	65	DD51	58	DD06	22	DC43	13	DD26	51	DD56	7	DD23	6	
DC45	65	DD22	58	BW19	22	DJ45	13	DD46	51	DDP1	7	CC20	6	
DD21	65	DC97	59	DD32	22	DD79	13	DD77	51	DD13	7	DD37	6	
DC42	65	DC66	59	DD48	22	DK22	13	DD53	51	DP18	7	DG35	6	
DC84	65	DD52	59	DC84	22	DC79	14	DC66	52	Z926	8	DD01	6	
DC99	66	DL52	60	DD66	22	DD83	14	DD18	52	DC52	8	T418	6	
DD77	66	DM85	60	E104	22	DM47	14	C145	52	DC82	8	DC74	6	
DD41	66	BY48	60	BY48	22	DC39	14	DC79	52	DD21	8	DP64	6	
DD22	67	E103	60	E101	22	DD68	14	DD11	53	E102	8	BW55	6	
DD03	67	DC98	60	DC92	22	DC49	14	DC36	54	DC75	8	DC41	8	
DD51	67	AY70	60	C182	22	DJ74	14	E103	54	DC71	8	DC73	6	
DJ74	67	DC93	61	DC85	22	DD78	14	E101	54	DC99	8	V191	8	
BP72	68	DD77	61	DD27	22	BY46	14	DD22	54	DD18	8	DD64	6	
DD07	68	DC42	61	T418	22	CA25	14	DD64	54	DD04	8	DC36	6	
DD23	68	DJ74	61	DC91	22	DD76	14	DD21	54	DM47	8	DD63	6	
DC53	68	DD21	62	DC79	22	DC83	14	DD63	54	BW19	8	DD57	6	
E102	69	CA25	62	DD75	22	AY70	14	DD62	54	DC65	8	DC72	6	
DC65	69	BY46	62	DC53	22	DM85	14	DC49	54	DC51	8	DD41	6	
E104	69	DD04	63	DD44	22	DL75	14	DC85	54	DM85	8	CA25	6	
DD61	70	DC96	63	DM77	23	DC51	14	DC95	54	DD79	8	DC48	6	
BY46	70	DC39	63	CE62	23	DJ89	14	DC71	55	DC63	8	DD05	8	
DC97	71	DC14	63	DM67	23	DC71	14	DD82	55	DD47	8	DC43	8	
DC93	71	DC84	63	DC63	23	DD46	14	DC39	55	AY70	8	DC38	8	
DD66	72	DD48	69	DD81	23	DD32	14	DJ87	56	DC84	8	DC89	6	
DD13	73	L693	65	DD68	23	DD43	14	DC75	57	DC42	8	DJ48	6	
DM77	73	DD78	65	C145	23	DD18	15	DD05	57	DD51	8	DJ74	6	

	TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		EXE STMTS	
DC39	75	E104	66	DC95	23	DC96	15	E104	57	DC83	8	DD48	6	
DC43	75	DD07	66	CS96	23	C102	15	DJ75	58	DC64	8	DC53	6	
CC20	76	DD68	66	DD51	23	DC55	15	DC14	58	DJ45	8	DC14	6	
DD68	76	DC65	67	DD13	23	DD11	15	DN02	58	DC81	8	DC92	6	
DD11	76	DD23	67	DC14	23	DD47	15	DD41	58	DD83	9	DC91	6	
DD48	76	Y265	67	DC49	23	DC84	15	DA47	58	DJ89	9	DC66	6	
C145	77	DP06	68	DJ74	23	DN02	15	DD01	60	C102	9	CS95	6	
DJ75	77	DC43	68	DD04	23	DM77	15	DD52	60	DD32	9	DK22	7	
Y265	78	DM77	68	DC96	23	DC92	15	DJ94	60	AR28	9	BY46	7	
L693	78	DD32	68	DD82	23	E102	15	DD78	61	DD77	9	DC85	7	
DD78	78	CS96	70	DD07	23	DC27	15	DC96	61	DD76	9	DD26	7	
DD04	78	DC41	70	BP72	23	AR28	15	DP26	61	DP26	9	DJ94	7	
DC52	79	DD13	70	DD87	23	DD51	15	Y265	62	DD11	9	DC79	7	
DC41	79	CC20	71	DD83	23	DD77	15	DD33	62	CE62	9	CE62	7	
DD64	79	DD68	71	DM47	23	CE62	15	DP06	62	DJ87	9	BP72	7	
DC95	80	DJ75	71	DC42	23	DD13	15	DC45	62	BY46	9	DC81	7	
DC96	81	DD03	72	DD36	24	DD03	15	DM77	62	DD78	9	DD82	7	
DC14	81	C145	72	DD11	24	DA47	16	DD66	62	DC96	9	DD43	7	
DP06	81	DD16	73	DC86	24	DD21	16	DC97	63	DJ94	9	DD72	7	
DC55	82	DJ94	74	Z926	24	DD26	16	DD48	64	DD53	10	DD18	7	
CS96	82	DN02	74	DC68	24	DD39	16	CS96	65	DD39	10	DC39	7	
DJ94	83	DC85	74	DC39	24	DD12	16	DC93	66	DD26	10	DP26	7	
DD32	84	DD64	75	L693	24	DC27	16	E102	66	DD06	10	DC82	7	
DD26	86	AR28	76	DD77	24	DD86	16	DD18	67	DC85	10	L693	7	
DN02	86	DC86	78	DD41	24	DD48	16	DC99	69	DD48	10	DD32	7	
DD18	87	DD11	78	DC66	24	BY48	16	L693	69	DA47	10	DC46	7	
DD43	88	DD18	79	DD56	24	Z926	16	AR28	70	DD33	10	DC95	8	
DC85	89	DD06	81	DD23	24	DD53	17	DD43	72	DC93	10	DDC7	8	
AR28	90	DD83	81	DJ75	24	DD06	17	DD06	73	DD68	10	DJ75	8	
DD06	92	DJ89	81	DJ94	24	DD33	17	DC86	73	DC79	10	DD83	8	
DJ89	93	DD26	84	DD64	25	E104	17	DD32	75	DD62	11	DJ89	8	
DP26	93	DC55	88	DD16	25	DD52	17	DC52	78	E103	11	DD78	8	
DD16	98	DD43	88	AR28	25	E103	18	DD36	88	DC97	11	DD52	9	
DD83	107	DP26	92	CC20	25	DJ94	18	DC82	89	DN02	11	DD16	9	
DC82	112	DC82	111	DC43	25	DC43	18	DJ89	90	DD12	11	DC52	9	
DD36	121	Z926	118	DC52	26	DD32	19	Z926	90	E104	11	AR28	9	
Z926	123	DD36	121	DD26	28	DC67	19	DD83	97	DD82	14	DD36	12	

WARNING: HEADING(S) ARE NOT CORRECT. AT LEAST ONE REFLECTS A SUM OF TWO COUNTS.

FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS



THE FOLLOWING PAIRS HAVE A CORRELATION OF 28:
ZZ00.ZZ01
ZZ00.ZZ02
ZZ03.ZZ04
ZZ05.ZZ06

THE FOLLOWING PAIRS HAVE A CORRELATION OF 29:
ZZ03.ZZ07

THE FOLLOWING PAIRS HAVE A CORRELATION OF 30:
ZZ01.ZZ02

NOTE: IDENTIFIER NAMES HAVE BEEN CHANGED

APPENDIX D

THIRD LISTING

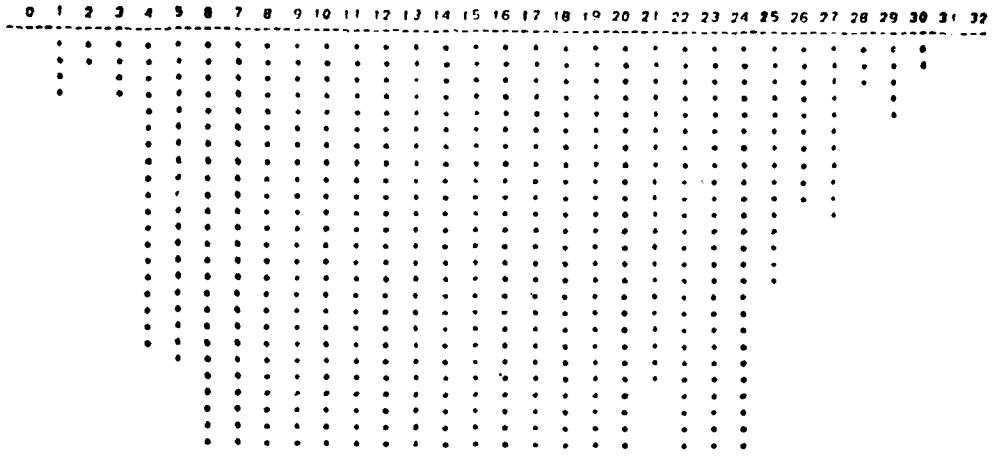
	TOTAL LINES	CODE LINES	CODE COMNT LINES	MULT STMT LINES	CONS AND TYPES	DECL VARS	VARS NOT USED	PROCS AND FUNCS	VAR PARAM	VAL PARAM	PROC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIQ OPERS	UNIQ OPNDS	TOTAL OPERS	TOTAL OPNDS	INFO FLOW FUNCTION	
1429	222	92	54	0	2	38	0	4	6	8	18	5	0	5	0	25	34	88	74	69	
1426	178	55	65	0	5	27	0	4	6	8	17	5	0	5	0	24	29	88	73	73	
1421	137	57	35	2	5	28	2	4	8	6	16	5	0	5	0	26	30	89	73	74	*
1430	123	57	35	3	2	27	1	4	6	8	17	5	0	5	0	25	31	90	77	74	*
1433	155	58	52	2	5	28	1	4	6	8	18	4	0	5	0	25	30	83	72	74	*
1417	113	57	24	0	4	29	1	4	6	8	17	5	0	5	0	24	31	87	72	75	*
1410	162	58	40	0	3	27	1	4	6	8	17	5	0	5	0	25	31	85	71	75	*
1402	145	59	30	0	4	28	1	4	6	8	18	5	0	5	0	24	30	87	72	77	*
1422	184	72	42	0	2	23	3	4	6	4	13	5	0	5	0	26	27	86	71	84	*
1410	126	57	44	0	3	26	0	4	6	8	16	5	0	5	0	25	30	90	77	[illegible]	
1425	148	57	53	0	3	27	0	4	6	8	17	5	0	5	0	25	31	87	73	[illegible]	
1411	267	54	80	0	2	30	0	4	6	9	20	7	0	4	0	24	35	89	74	[illegible]	
1418	130	57	40	0	3	31	0	4	6	8	21	7	0	4	0	24	35	88	71	[illegible]	
1413	182	64	85	0	2	37	0	5	6	14	20	5	0	5	0	26	40	97	80	[illegible]	
1420	155	57	36	0	4	27	0	4	6	8	17	5	0	5	0	25	31	85	73	[illegible]	
1437	157	59	78	1	5	28	0	4	6	8	17	5	1	4	0	28	32	95	81	[illegible]	
1432	165	56	49	0	2	24	4	4	13	1	14	5	0	5	0	27	28	96	82	[illegible]	*
1409	122	66	27	0	4	31	0	4	7	8	21	5	0	5	0	24	33	89	73	[illegible]	
1415	187	59	57	0	2	28	0	4	6	8	18	5	0	5	0	24	32	86	72	[illegible]	
1428	159	58	40	0	3	31	1	4	6	8	19	5	0	5	0	25	34	93	74	[illegible]	*
1416	108	56	22	1	2	28	2	4	6	8	18	6	0	3	0	24	32	83	71	[illegible]	*
1401	145	67	37	1	2	30	0	4	7	7	17	7	0	6	0	25	34	118	102	[illegible]	
1435	99	56	19	0	2	30	0	4	6	8	20	5	0	5	0	25	34	100	89	[illegible]	
1438	113	53	25	0	3	27	0	4	6	8	17	5	0	4	0	24	31	86	71	[illegible]	
1406	158	58	21	0	5	27	1	4	6	8	17	5	0	5	0	24	29	87	72	[illegible]	*
1427	131	58	37	0	2	23	4	4	6	5	12	5	1	3	0	26	27	86	70	[illegible]	*
1436	177	64	25	0	2	28	1	4	6	8	16	5	0	5	0	24	30	84	69	[illegible]	*
1438	106	49	23	2	2	28	0	4	6	8	18	5	1	4	0	27	32	86	73	[illegible]	
1441	145	55	36	0	5	26	2	4	8	5	16	5	0	5	0	24	28	88	72	[illegible]	*
1419	182	55	55	0	5	29	0	4	6	8	19	5	1	4	0	27	31	86	75	[illegible]	
1412	165	65	29	0	3	27	2	4	6	8	17	5	1	4	0	28	31	102	88	[illegible]	*
1427	189	65	27	0	4	30	2	4	7	7	18	5	0	5	0	26	32	96	80	[illegible]	*
1408	154	56	24	0	2	27	0	4	6	8	17	5	1	4	0	27	32	92	84	[illegible]	
1431	127	57	21	0	2	30	2	4	6	8	18	5	0	5	0	26	34	85	71	[illegible]	*
1423	194	60	56	1	3	27	0	4	6	8	14	5	1	4	0	28	31	95	81	[illegible]	
1424	146	56	48	1	5	27	3	4	6	8	17	5	0	5	0	26	31	89	72	[illegible]	*
1414	109	55	26	0	2	30	0	4	6	8	20	7	1	3	0	25	34	87	74	[illegible]	
1434	124	59	43	0	2	28	0	4	6	8	18	5	0	5	0	25	32	93	76	[illegible]	
1439	174	58	58	0	7	26	1	4	6	8	16	4	0	5	0	25	30	90	82	[illegible]	*
1404	187	60	80	0	3	28	0	4	6	8	17	5	2	3	0	26	33	97	85	[illegible]	
1405	189	56	41	0	5	29	0	4	6	8	19	5	1	4	0	26	31	90	78	[illegible]	
1412	291	59	80	0	3	30	1	4	6	8	20	7	1	2	0	27	35	91	74	[illegible]	*
1403	143	61	32	0	2	29	0	4	6	8	19	6	0	5	0	26	35	102	82	[illegible]	

* VARIABLE(S) WERE DECLARED BUT NOT USED
** PROCEDURE(S) WERE DECLARED BUT NOT USED
*** VARIABLE(S) AND PROCEDURE(S) WERE DECLARED BUT NOT USED

TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR STMTS	
1433	83	1436	69	1406	24	1407	27	1438	49	1407	23	1439	9
1418	83	1407	70	1415	24	1422	27	1429	52	1422	23	1418	9
1436	84	1422	71	1402	24	1431	28	1428	53	1432	24	1428	9
1440	85	1431	71	1417	24	1402	28	1411	54	1439	26	1407	9
1420	85	1428	71	1409	24	1426	29	1414	55	1421	26	1433	9
1404	85	1418	71	1411	24	1406	29	1441	55	1410	26	1415	10
1431	85	1440	71	1441	24	1410	30	1419	55	1436	26	1405	10
1428	86	1418	71	1426	24	1439	30	1426	55	1441	26	1424	10
1415	86	1402	72	1428	24	1421	30	1405	56	1440	27	1436	10
1429	86	1417	72	1436	24	1433	30	1416	56	1430	27	1437	10
1441	86	1406	72	1416	24	1406	30	1404	56	1425	27	1402	10
1419	86	1415	72	1418	24	1402	30	1432	56	1427	27	1419	10
1407	86	1404	72	1429	25	1410	31	1435	56	1406	27	1409	10
1438	86	1433	72	1E28	25	1423	31	1408	56	1408	27	1412	10
1422	88	1441	72	1425	25	1428	31	1430	57	1426	27	1413	10
1406	87	1426	73	1435	25	1419	31	1418	57	1442	27	1E28	10
1425	87	1409	73	1434	25	1417	31	1425	57	1428	27	1431	10
1402	87	1421	73	1410	25	1420	31	1431	57	1404	27	1429	10
1414	87	1438	73	1414	25	1405	31	1410	57	1423	27	1417	10
1417	87	1420	73	1430	25	1439	31	1421	57	1433	28	1435	10
1418	88	1425	73	1439	25	1432	31	1420	57	1434	28	1427	10
1426	88	1412	74	1433	25	1425	31	1417	57	1437	28	1432	10
1411	89	1E28	74	1440	25	1404	31	1439	58	1438	28	1421	10
1421	89	1429	74	1401	25	1415	32	1433	58	1416	28	1425	10
1409	89	1414	74	1420	25	1416	32	1E28	58	1402	28	1430	10
1405	90	1411	74	1427	26	1438	32	1407	58	1415	28	1436	10
1439	90	1419	75	1403	26	1437	32	1406	58	1424	28	1410	10
1430	90	1434	76	1405	26	1409	32	1440	58	1403	29	1440	10
1410	90	1410	77	1413	26	1434	32	1412	59	1405	29	1441	10
1412	91	1430	77	1431	26	1427	32	1437	59	1419	29	1420	10
1408	92	1405	78	1422	26	1409	33	1415	59	1417	29	1404	10
1E28	93	1427	80	1407	26	1424	33	1402	59	1414	30	1442	10
1434	93	1413	80	1421	26	1435	34	1434	59	1429	30	1434	10
1437	95	1423	81	1424	26	1E28	34	1423	60	1411	30	1423	10
1423	95	1437	81	1404	26	1429	34	1424	60	1401	30	1426	10
1427	96	1403	82	1408	27	1431	34	1403	61	1427	30	1406	10
1432	96	1432	82	1432	27	1401	34	1413	64	1435	30	1422	10
1424	97	1439	82	1412	27	1414	34	1436	64	1431	30	1408	10
1413	97	1408	84	1438	27	1411	35	1442	65	1412	30	1418	11
1435	100	1424	85	1419	27	1418	35	1427	65	1409	31	1414	11
1403	102	1442	88	1437	28	1403	35	1409	66	1E28	31	1403	11
1442	102	1435	89	1423	28	1412	35	1401	67	1418	31	1411	11
1401	116	1401	102	1442	28	1413	40	1422	72	1413	37	1401	13

WARNING: HEADING(S) ARE NOT CORRECT. AT LEAST ONE REFLECTS A SUM OF TWO COUNTS.

FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS



THE FOLLOWING PAIRS HAVE A CORRELATION OF 28:
T402,T417
T404,T440
T417,T425

THE FOLLOWING PAIRS HAVE A CORRELATION OF 29:
T402,T406
T402,T415
T404,T420
T420,T440
T423,T437

THE FOLLOWING PAIRS HAVE A CORRELATION OF 30:
T410,T430
T420,T425

APPENDIX E

FOURTH LISTING

	TOTAL LINES	CODE LINES	CODE COMNT LINES	MULT STMT LINES	CONS AND TYPES	DECL VARS	VARS NOT USED	PROCS AND FUNCS	VAR PARAM	VAL PARAM	PROC VARS	FOR STMTS	REP STMTS	WHILE STMTS	GOTO STMTS	UNIQ OPERS	UNIQ OPNDS	TOTAL OPERS	TOTAL OPNDS	PRINTING FUNCTION
H130	167	51	63	0	3	11	0	2	3	2	8	0	0	4	0	25	13	113	95	[illegible]
H107	133	44	38	0	4	17	2	3	9	1	8	1	0	3	0	25	21	79	64	[illegible] •
H129	174	68	39	0	4	23	1	4	7	4	16	0	0	6	0	26	26	119	80	[illegible] •
H122	235	80	64	0	4	33	0	5	11	6	19	3	0	3	0	30	36	147	110	[illegible]
H114	175	51	49	0	4	19	3	5	3	5	13	3	0	2	0	28	23	67	48	[illegible] •
H110	150	57	39	0	4	20	1	5	7	4	12	4	1	1	0	30	25	98	71	[illegible] •
H126	131	53	32	0	3	15	2	4	1	4	8	3	0	3	0	26	18	64	50	[illegible] •
H124	162	60	45	0	4	20	2	4	5	4	11	3	0	3	0	28	23	112	82	[illegible] •
H103	158	57	41	0	4	25	0	3	6	2	14	4	0	3	0	29	28	117	94	[illegible]
H109	138	60	33	0	3	13	0	2	2	0	4	8	0	5	0	26	16	127	78	[illegible]
H115	163	60	48	0	4	18	0	3	4	0	7	3	0	2	0	26	21	93	70	[illegible]
H119	179	70	43	0	4	13	6	4	6	2	5	3	0	3	0	28	16	89	59	[illegible] •
H118	182	53	85	0	3	29	1	4	8	5	17	3	0	5	0	26	27	105	65	[illegible] •
H132	124	44	36	0	3	7	0	5	1	3	4	0	0	2	0	30	10	98	58	[illegible]
H102	174	62	43	0	3	22	1	3	5	2	10	3	0	3	0	27	27	95	72	[illegible] •
H106	148	51	27	1	3	20	0	3	5	3	10	0	0	4	0	26	23	101	74	[illegible]
H127	136	68	37	0	3	8	6	3	2	0	3	4	0	3	0	27	12	103	66	[illegible] •
H105	172	64	56	0	2	18	0	2	3	0	7	1	1	3	0	27	20	90	69	[illegible]
H123	204	48	56	0	4	17	6	5	8	5	12	6	0	3	0	27	21	71	49	[illegible] •
H133	187	62	62	0	5	24	1	5	5	7	16	0	0	4	0	30	27	105	82	[illegible] •
H116	167	66	42	0	4	15	2	5	4	2	8	0	0	5	0	27	18	87	68	[illegible] •
H101	179	64	39	0	5	24	3	4	11	2	15	5	0	1	0	28	29	133	86	[illegible] •
H120	201	69	58	0	4	18	0	4	3	3	11	1	0	4	0	29	22	107	71	[illegible]
H125	178	60	47	0	3	26	0	4	11	1	16	4	0	2	0	28	28	92	63	[illegible]
H113	238	88	44	0	4	18	2	4	2	2	8	0	0	5	0	31	21	151	102	[illegible] •
H111	146	62	48	0	3	12	4	4	4	2	6	0	0	5	0	26	15	100	75	[illegible] •
H112	178	71	37	0	4	15	2	4	4	4	8	3	0	4	0	30	20	131	94	[illegible] •
H[illegible]	133	68	34	0	3	10	0	1	2	0	2	0	0	6	0	22	15	114	83	[illegible]
H[illegible]	[illegible]	70	41	0	3	20	3	5	6	3	12	2	0	6	0	28	22	102	71	[illegible] •
H[illegible]	[illegible]	82	55	0	3	20	1	4	3	6	10	4	0	2	0	29	23	121	88	[illegible] •
H[illegible]	[illegible]	73	51	0	4	22	4	5	9	0	14	3	0	3	0	28	25	108	71	[illegible] •
H[illegible]	[illegible]	76	55	0	3	23	0	4	3	4	14	3	0	4	0	26	25	97	68	[illegible]
H[illegible]	[illegible]	95	53	0	8	32	5	6	13	8	23	4	0	3	0	31	35	199	168	[illegible] •

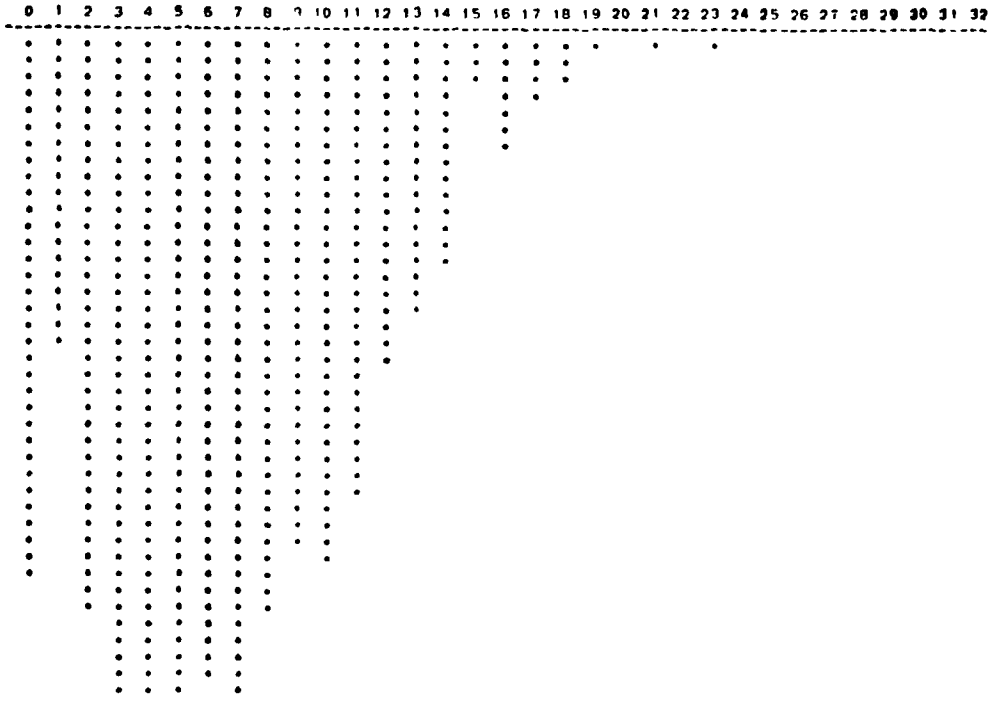
* VARIABLE(S) WERE DECLARED BUT NOT USED
** PROCEDURE(S) WERE DECLARED BUT NOT USED
*** VARIABLE(S) AND PROCEDURE(S) WERE DECLARED BUT NOT USED

	TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR SIMS
M126	64	M114	48	M117	22	M132	10	M107	44	M132	7	M132	2
M114	67	M123	49	M107	25	M127	12	M132	44	M127	8	M130	4
M123	71	M126	50	M130	25	M130	13	M123	49	M117	10	M107	4
M107	79	M132	58	M115	26	M117	15	M114	51	M13[illegible]	11	M133	4
M118	87	M125	63	M129	26	M111	15	M106	51	M111	12	M106	4
M105	90	M107	64	M106	26	M109	16	M130	51	M109	13	M113	5
M125	92	M118	68	M111	26	M113	16	M126	53	M119	13	M105	5
M115	93	M127	68	M109	26	M126	18	M118	53	M116	15	M114	5
M119	95	M128	68	M128	26	M116	18	M103	57	M112	15	M115	5
M102	95	M116	68	M118	26	M105	20	M110	57	M126	15	M120	5
M132	96	M105	69	M126	26	M112	20	M125	60	M105	16	M116	5
M110	96	M119	69	M123	27	M115	21	M124	60	M113	16	M111	5
M128	97	M115	70	M118	27	M107	21	M109	60	M123	17	M104	6
M106	101	M120	71	M105	27	M123	21	M115	60	M107	17	M110	6
M108	102	M104	71	M102	27	M119	21	M133	62	M12[illegible]	18	M124	6
M127	103	M110	71	M127	27	M108	22	M111	62	M115	18	M102	6
M133	105	M108	71	M124	28	M120	22	M102	62	M114	19	M125	6
M118	105	M102	72	M101	28	M114	23	M101	64	M108	20	M122	6
M120	107	M106	74	M119	28	M131	23	M105	64	M131	20	M129	6
M104	108	M111	75	M114	28	M124	23	M116	66	M106	20	M101	6
M111	108	M109	78	M125	28	M106	23	M129	68	M11[illegible]	20	M126	6
M124	112	M129	80	M108	28	M110	25	M127	68	M124	20	M119	6
M130	113	M124	82	M104	28	M128	25	M117	68	M104	22	M117	6
M117	114	M133	82	M103	29	M104	25	M120	69	M102	22	M131	6
M129	115	M117	83	M120	29	M129	26	M108	70	M128	23	M103	7
M103	117	M101	86	M131	29	M133	27	M119	70	M129	23	M121	7
M131	121	M131	88	M122	30	M102	27	M112	71	M133	24	M112	7
M109	127	M112	94	M112	30	M118	27	M104	73	M101	24	M128	7
M112	131	M103	94	M110	30	M125	28	M128	76	M103	25	M127	7
M101	133	M130	95	M133	30	M103	28	M122	80	M118	25	M108	8
M122	147	M113	102	M132	30	M101	29	M131	82	M125	26	M118	8
M113	151	M122	110	M121	31	M121	35	M113	88	M121	32	M123	9
M121	199	M121	168	M113	31	M122	36	M121	95	M122	33	M109	13

WARNING: HEADING(S) ARE NOT CORRECT. AT LEAST ONE REFLECTS A SUM OF TWO COUNTS.

TUKEY ESTIMATE FOR SUSPICION OF PLAGIARISM: 28

FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS



APPENDIX F

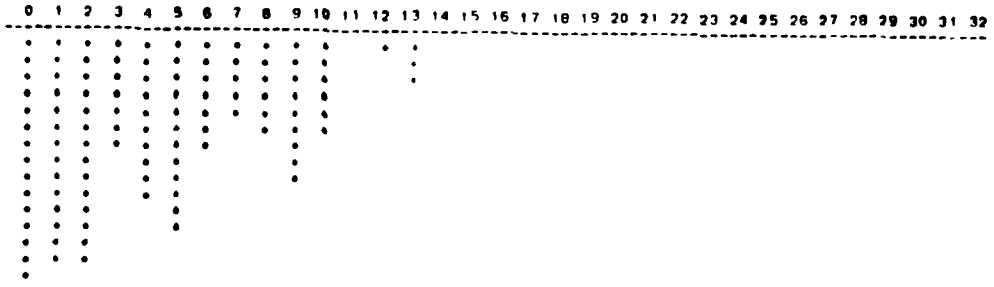
FIFTH LISTING

	TOTAL OPERS		TOTAL OPNDS		UNIQ OPERS		UNIQ OPNDS		CODE LINES		DECL VARS		FOR STMTS	
M210	82	M204	63	M210	26	M204	27	M204	57	M204	23	M210	6
M204	83	M210	73	M216	29	M210	31	M210	58	M214	26	M214	7
M216	99	M216	85	M204	30	M214	33	M205	63	M205	27	M202	8
M205	139	M205	114	M211	33	M205	35	M216	69	M210	28	M216	8
M209	145	M207	126	M214	34	M207	36	M213	73	M207	32	M207	8
M211	152	M209	129	M203	35	M213	37	M214	74	M216	34	M209	8
M203	158	M211	136	M212	35	M216	39	M211	75	M213	34	M205	8
M207	165	M203	138	M209	36	M202	43	M203	80	M215	36	M211	9
M214	166	M212	141	M213	37	M208	43	M209	82	M202	37	M212	9
M202	181	M202	145	M202	37	M215	43	M202	84	M203	38	M215	9
M213	192	M214	145	M207	37	M203	44	M207	86	M208	39	M204	9
M212	202	M213	151	M208	38	M206	44	M212	88	M206	39	M213	10
M215	202	M215	165	M206	39	M211	48	M215	91	M211	39	M208	10
M208	227	M201	173	M201	40	M212	46	M208	100	M212	39	M203	12
M201	245	M208	197	M206	41	M209	48	M201	123	M201	41	M206	12
M206	295	M206	275	M215	41	M201	48	M206	124	M209	44	M201	13

WARNING: HEADING(S) ARE NOT CORRECT. AT LEAST ONE REFLECTS A SUM OF TWO COUNTS.

TUKEY ESTIMATE FOR SUSPICION OF PLAGIARISM: 22

FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS



APPENDIX G

EXAMPLE OF A PAIR OF PROGRAMS WITH CORRELATION NUMBER EQUAL TO 29

```
2203

VARS

I,J
LIMIT
NEXTITEM
MAXNUMLINES
MAXNUMITEMS

BEGIN
WHILE NOT EOF DO
BEGIN
READLN(MAXNUMLINES,MAXNUMITEMS)
WRITELN('1')
IF MAXNUMLINES<0 THEN
WRITELN('INCORRECT DATA')
ELSE IF MAXNUMLINES>25 THEN
WRITELN('TOO MANY LINES REQUESTED')
ELSE IF MAXNUMITEMS<0 THEN
WRITELN('INSUFFICIENT DATA')
ELSE IF MAXNUMITEMS>50 THEN
WRITELN('OVERSUFFICIENT DATA')
ELSE BEGIN
LIMIT := MAXNUMITEMS DIV 5
IF MAXNUMITEMS MOD 5 <> 0 THEN
LIMIT := LIMIT + 1;
WRITE(' 0')
FOR I := 1 TO LIMIT DO
WRITE(I:5:5); WRITELN

WRITE(' ')
FOR I := 1 TO LIMIT DO
WRITE('-----')
WRITELN
WRITELN('0':3)
FOR I := 1 TO MAXNUMLINES DO BEGIN
WRITE(' ')
READ(NEXTITEM)
IF NEXTITEM<0 THEN
WRITELN('--')
ELSE BEGIN
WRITE('*')

IF NEXTITEM>MAXNUMITEMS THEN
NEXTITEM := MAXNUMITEMS
FOR J := 1 TO NEXTITEM DO
WRITE('*')
IF NEXTITEM=MAXNUMITEMS THEN
WRITE('+')
WRITELN
END
WRITELN(I:3)
END
END
READLN
END
END
```

```
2203

VARS

I,J
LIMIT
NEXTITEM
MAXNUMLINES
MAXNUMITEMS
MINITEM

BEGIN
WHILE NOT EOF DO
BEGIN
READLN(MAXNUMLINES,MAXNUMITEMS)
WRITELN('1')
IF MAXNUMLINES<0 THEN
WRITELN('INCORRECT DATA')
ELSE IF MAXNUMLINES>25 THEN
WRITELN('TOO MANY LINES REQUESTED')
ELSE IF MAXNUMITEMS<0 THEN
WRITELN('INSUFFICIENT DATA')
ELSE IF MAXNUMITEMS>50 THEN
WRITELN('OVERSUFFICIENT DATA')
ELSE BEGIN
LIMITS := MAXNUMITEMS DIV 5
IF MAXNUMITEMS MOD 5 <> 0 THEN
LIMITS := LIMITS + 1;
WRITE(' 0')
FOR I := 1 TO LIMITS DO
WRITE(I:5:5)
WRITELN

WRITE(' ')
FOR I := 1 TO LIMITS DO
WRITE('-----')
WRITELN
WRITELN('0':3)
FOR I := 1 TO MAXNUMLNS DO BEGIN
WRITE(' ')
READ(NEXTITEM)
IF NEXTITEM<0 THEN
WRITELN('--')
ELSE BEGIN
WRITE('*')
MINITEM := NEXTITEM
IF NEXTITEM>MAXNUMITEMS THEN
MINITEM := MAXNUMITEMS
FOR J := 1 TO MINITEM DO
WRITE('*')
IF NEXTITEM=MAXNUMITEMS THEN
WRITE('+')
WRITELN
END
WRITELN(I:3)
END
END
READLN
END
END
```

```
000004  0     1
000004  0     2  (*$R-*)
000004  0     3  PROGRAM  ACCUSE (INPUT,OUTPUT);
000074  0     4
000074  0     5  (*  SAM GRIER
000074  0     6      THESIS
000074  0     7
000074  0     8      EENIE, MEENIE, MINIE, MO, CATCH A CHEATER BY THE TOE...  *)
000074  0     9
000074  0    10
000074  0    11  LABEL     1;   (* TERMINATES THE PROGRAM AT EOF *)
000074  0    12
000074  0    13  CONST
000074  0    14        NUMKEYWORDS = 150;  (* NUMBER OF KEYWORDS IN PASCAL *)
000074  0    15        MAXCHAR     =  63;  (* MAXIMUM CHARACTER ORDINAL *)
000074  0    16        QUOTE       ="'";   (* STRING QUOTE *)
000074  0    17        MAXSTRING   = 120;  (* LENGTH OF ANY LINE OF INPUT *)
000074  0    18        LNLIM       = 121;  (* MAXSTRING + 1 *)
000074  0    19        MAXNESTLEVEL=  50;  (* MAXIMUM NEST OF PROCEDURES *)
000074  0    20        MAXMODULE   = 140;  (* MAXIMUM NMBR OF PROGRAMS THAT CAN BE PROCESSED PLUS ONE *)
000074  0    21        CCIDLNGTH   =   4;  (* THE LENGTH OF THE COMPUTING CENTER I.D. *)
000074  0    22        PARACOUNT   =  20;  (* NMBR OF PARAMETERS BEING COUNTED *)
000074  0    23        SIGINDENT   =   2;  (* SIGNIFICANT INDENTATION *)
000074  0    24        CCIDPERPAGE =  50;  (* NUMBER OF COUNTS PRINTED PER PAGE *)
000074  0    25
000074  0    26  TYPE
000074  0    27        COUNTCLASS  = (
000074  0    28                       EPLIN,  (* LINES IN PROGRAM *)
000074  0    29                       EPOPS,  (* OPERATORS IN ENTIRE PROGRAM *)
000074  0    30                       EPCT,   (* TYPES AND CONSTANTS IN ENTIRE PROGRAM *)
000074  0    31                       UNOPN,  (* UNIQUE OPERANDS IN PROGRAM *)
000074  0    32                       EPVAR,  (* VARIABLES IN ENTIRE PROGRAM *)
000074  0    33                       VARPA,  (* NUMBER OF VAR PARAMETERS *)
000074  0    34                       PRVAR,  (* NUMBER OF VARIABLES IN PROCEDURES *)
000074  0    35                       EPPRO,  (* NUMBER OF PROCEDURES AND FUNCTIONS *)
000074  0    36                       EPOPN,  (* OPERANDS IN ENTIRE PROGRAM *)
000074  0    37                       FORCT,  (* NUMBER OF FOR STMTS *)
000074  0    38                       GOCNT,  (* NUMBER OF GOTO STMTS *)
000074  0    39                       REPCT,  (* NUMBER OF REPEAT STMTS *)
000074  0    40                       WHICT,  (* NUMBER OF WHILE STMTS *)
000074  0    41                       EPCOM,  (* LINES OF COMMENTS IN THE PROGRAM *)
000074  0    42                       EPMOL,  (* LINES WITH MORE THAN ONE STMT *)
000074  0    43                       VALPA,  (* NUMBER OF VAL PARAMETERS *)
000074  0    44                       EPCL,   (* CODE LINES IN PROGRAM *)
000074  0    45                       INDNF,  (* RELATIVE INDENTING FUNCTION *)
000074  0    46                       UNOPS,  (* UNIQUE OPERATORS IN PROGRAM *)
000074  0    47                       VARNU); (* VARIABLES DECLARED BUT NOT USED *)
000074  0    48
000074  0    49        TOKTYP      = (
000074  0    50                       LBLDEC,  (* PROCESS A LABEL DECL *)
000074  0    51                       CONDEC,  (* PROCESS A CONSTANT DECL *)
000074  0    52                       TYPDEC,  (* PROCESS A TYPE DECL *)
000074  0    53                       VARDEC,  (* PROCESS A VAR DECL *)
000074  0    54                       VALDEC,  (* PROCESS A VALUE DECL *)
000074  0    55                       PROG,    (* PROCESS THE PROGRAM DECL *)
000074  0    56                       PROCS,   (* PROCESS A PROCEDURE OR FUNCTION DECL *)
000074  0    57                       FWD,     (* PROCESS A FORWARD DECL *)
```

APPENDIX H

CODE FOR PROGRAM ACCUSE

```
000074  0    58                    CASEST,  (* PROCESS A CASE STMT *)
000074  0    59                    FINDOF,  (* PROCESS AN OF *)
000074  0    60                    FINDBEG, (* PROCESS A BEGIN *)
000074  0    61                    FINDEND, (* PROCESS AN END *)
000074  0    62                    LPAR,    (* PROCESS LEFT PAREN *)
000074  0    63                    RPAR,    (* TERMINATE LEFT PAREN *)
000074  0    64                    FORST,   (* PROCESS A FOR STMT *)
000074  0    65                    GOTOST,  (* PROCESS A GOTO STMT *)
000074  0    66                    INST,    (* PROCESS AN IF STMT *)
000074  0    67                    REPST,   (* PROCESS A REPEAT STMT *)
000074  0    68                    WHIST,   (* PROCESS A WHILE STMT *)
000074  0    69                    COMNT,   (* PROCESS A COMMENT *)
000074  0    70                    LBRAC,   (* PROCESS AN ARRAY SUBSCRIPT *)
000074  0    71                    SEMI,    (* PROCESS A SEMI-COLON *)
000074  0    72                    OPND,    (* PROCESS AN OPERAND *)
000074  0    73                    NMBR,    (* PROCESS A NUMBER *)
000074  0    74                    BLNKS,   (* PROCESS ONE OR MORE BLANKS *)
000074  0    75                    DOLLAR,  (* INCORRECT $ POSITION *)
000074  0    76                    EOLNM,   (* PROCESS AN EOLN *)
000074  0    77                    EOLNSM,  (* PROCESS AN EOLNS *)
000074  0    78                    EOFM,    (* PROCESS AN EOF *)
000074  0    79                    EOFSM,   (* PROCESS AN EOFS *)
000074  0    80                    TERM,    (* TERMINATE CURRENT PROGRAM *)
000074  0    81                    ENDLIST, (* TERMINATE A CLAUSE *)
000074  0    82                    ABT,     (* ABORT CURRENT PROGRAM *)
000074  0    83                    FUNCS,   (* PROCESS A FUNCTION *)
000074  0    84                    RECDEC,  (* PROCESS A RECORD DECL *)
000074  0    85                    TOST,    (* PROCESS A TO STMT *)
000074  0    86                    WITHST,  (* PROCESS A WITH STMT *)
000074  0    87                    RBRAC,   (* TERMINATE ARRAY SUBSCRIPT *)
000074  0    88                    EQUAL,   (* PROCESS = *)
000074  0    89                    COLON,   (* PROCESS A COLON *)
000074  0    90                    ASSIGN,  (* PROCESS ASSIGNMT STMT *)
000074  0    91                    COMMA,   (* PROCESS A COMMA *)
000074  0    92                    DUMMY);  (* DO NOTHING *)
000074  0    93
000074  0    94        SYMLINK     = ^RESSYMBOL;(* POINTER TO RESERVED WORDS *)
000074  0    95
000074  0    96        RESSYMBOL   = RECORD
000074  1    97                      STRING:   ALFA;      (* KEYWORD *)
000074  1    98                      LNGTH:    INTEGER;   (* LENGTH OF WORD *)
000074  1    99                      OP:       BOOLEAN;   (* TRUE IF OPERATOR *)
000074  1   100                      USED:     BOOLEAN;   (* TRUE IF OPERATOR USED *)
000074  1   101                      NEXTSYM:  SYMLINK;   (* NEXT SYMBOL IN TABLE *)
000074  1   102                      LASTSYM:  SYMLINK;   (* PREVIOUS SYMBOL IN TABLE *)
000074  1   103                      NEXTTMP:  SYMLINK;   (* USER FUNCTION LINKAGE PTR *)
000074  1   104                      TOK:      TOKTYP;    (* TOKEN TYPE *)
000074  1   105    (* RESSYMBOL *)  END;
000074  0   106
000074  0   107        CHBUFF      = ARRAY [1..10] OF CHAR:  (* UTILITY BUFFER DECL *)
000074  0   108        TEXINDX     = 1..MAXSTRING:           (* ALLOWABLE IDENBUFF INDICES *)
000074  0   109        MAXTEXT     = 1..LNLIM;               (* ALLOWABLE LINE INDICES *)
000074  0   110        MODULENUMBERS= 1..MAXMODULE;          (* POSSIBLE MODULE NUMBERS *)
000074  0   111
000074  0   112  VAR
000074  0   113      KEYWORDS:          (* KEYWORDS FOR SYMBOL TABLE INITIALIZATION *)
000074  0   114                 ARRAY [1..NUMKEYWORDS] OF RESSYMBOL;
```

```
002434  0   115
002434  0   116     SYMTBL:             (* SYMBOL TABLE THAT CONTAINS PASCAL KEYWORDS *)
002434  0   117             ARRAY [CHAR] OF SYMLINK;
002534  0   118
002534  0   119     CHTBL:              (* SCANNER TABLE *)
002534  0   120             ARRAY [CHAR] OF 0..12;
002634  0   121
002634  0   122     ACTION:  TOKTYP;    (* ACTION TO BE PERFORMED BY THE DRIVER *)
002635  0   123     COUNTER:            (* PARAMETER TO BE COUNTED BY COUNT *)
002635  0   124             COUNTCLASS;
002636  0   125
002636  0   126     IDENBUFF:           (* IDENTIFIER BUFFER *)
002636  0   127             ARRAY [TEXTINDX] OF CHAR;
003026  0   128     ENDIDEN: TEXTINDX; (* INDEX TO IDENBUFF *)
003027  0   129
003027  0   130     LINE:               (* INPUT LINE *)
003027  0   131             ARRAY [MAXTEXT] OF CHAR;
003220  0   132     INDEX,              (* INDEX TO LINE *)
003220  0   133     ENDLINE: MAXTEXT; (* LAST CHARACTER + 1 OF ANY LINE *)
003222  0   134
003222  0   135     LINESOFCOMMENT,     (* NUMBER OF LINES IN COMMENT BEING PROCESSED *)
003222  0   136
003222  0   137     NUMBLNKS:           (* NUMBER OF BLANKS BEING PROCESSED *)
003222  0   138             INTEGER;
003224  0   139
003224  0   140     NEWLINE,            (* TRUE IF A LINE IS YET UNPROCESSED *)
003224  0   141     ISADELIMITER,       (* TRUE IF ITEM IS A DELIMITER *)
003224  0   142     KEYWORD: BOOLEAN; (* TRUE IF AN IDENTIFIER IS A KEYWORD *)
003227  0   143
003227  0   144     PTRTOSYMTBL,        (* UTILITY POINTER FOR THE SYMBOL TABLE *)
003227  0   145     PTRTONEWREC:        (* POINTER USED TO CREATE NEW RECORDS *)
003227  0   146             SYMLINK;
003231  0   147
003231  0   148     AMTFWDDEC,          (* NUMBER OF FORWARD DECL *)
003231  0   149     STARTPOS: INTEGER; (* INDEX FOR COMPUTING INDENFUNC *)
003233  0   150
003233  0   151     YES,                (* IF TRUE THEN DRIVER CALLS SCANNER *)
003233  0   152     SAMELINE,           (* SET TRUE AFTER FIRST STMT PER LINE *)
003233  0   153     INIP,               (* TRUE IF IN AN IN STMT *)
003233  0   154     FWDDEC,             (* TRUE IF PROCESSING A FORWARD DECL *)
003233  0   155     PRODECL,            (* TRUE IF PROCESSING A PROCEDURE DECL *)
003233  0   156     PARADEC:            (* TRUE IF PROCESSING FORMAL PARAMETERS *)
003233  0   157             BOOLEAN;
003241  0   158     PRODECLNOTUSED:     (* TRUE IF ANY PROCEDURE IS DECLARED BUT NOT USED *)
003241  0   159             ARRAY [MODULENUMBERS] OF BOOLEAN;
003455  0   160
003455  0   161     HEADNMBR:           (* HEAD OF THE LIST OF UNIQUE NUMBERS *)
003455  0   162             SYMLINK;
003456  0   163
003456  0   164     NESTLEVEL:          (* POSSIBLE NESTLEVELS ARE 1..MAXNESTLEVEL *)
003456  0   165             0..MAXNESTLEVEL;
003457  0   166     HEADREDEF,          (* LIST OF REDEFINED KEYWORDS AT EACH NESTLEVEL *)
003457  0   167     DECLIST,            (* LIST OF VARS AT EACH NESTLEVEL *)
003457  0   168     HEADTEMP:           (* LIST OF USER DEFINED FUNCTIONS AT EACH NESTLEVEL *)
003457  0   169             ARRAY [1..MAXNESTLEVEL] OF SYMLINK;
003705  0   170     STARTPROC:          (* ENABLES PROGRAM TO TERMINATE PROCEDURES *)
003705  0   171             ARRAY [1..MAXNESTLEVEL] OF INTEGER;
```

```
003767  0   172
003767  0   173      MODULE:             (* INDEX FOR PROGNOSIS AND CCID *)
003767  0   174              0..MAXMODULE;
003770  0   175      PROGNOSIS:          (* ARRAY OF PARAMETERS OF INDIVIDUAL PROGRAMS *)
003770  0   176              ARRAY [MODULENUMBERS,1..PARACOUNT] OF INTEGER;
011350  0   177      ORDER:              (* ARRAY OF SORTED MODULES *)
011350  0   178              ARRAY [MODULENUMBERS] OF MODULENUMBERS;
011564  0   179      CCID:               (* CCID ARRAY *)
011564  0   180              PACKED ARRAY [MODULENUMBERS,1..CCIDLNGTH] OF CHAR;
011672  0   181
011672  0   182      KEY,                (* FINGERPRINT ELEMENT USED TO SORT PROGNOSIS *)
011672  0   183      NUMBEG,             (* CURRENT NUMBER OF BEGINS *)
011672  0   184      NUMCASE,            (* CURRENT NUMBER OF CASE STMTS *)
011672  0   185      TOTALLINES,         (* NUMBER OF TOTAL LINES IN PROGRAM *)
011672  0   186      OPERATORS,          (* NUMBER OF OPERATORS IN PROGRAM *)
011672  0   187      CONSANDTYPES,       (* NUMBER OF DIFFERENT CONSTANTS AND TYPES *)
011672  0   188      UNIQUEOPN,          (* UNIQUE OPERANDS IN PROGRAM *)
011672  0   189      VARIABLES,          (* VARIABLES IN THE PROGRAM *)
011672  0   190      VARPARA,            (* VAR PARAMETERS IN PROGRAM *)
011672  0   191      PROVAR,             (* PROCEDURE VARIABLES IN PROGRAM *)
011672  0   192      PROCANDFUNC,        (* PROCEDURES AND FUNCTIONS IN PROGRAM *)
011672  0   193      OPERANDS,           (* OPERANDS IN ENTIRE PROGRAM *)
011672  0   194      FORSIMT,            (* NUMBER OF FOR STMT IN PROGRAM *)
011672  0   195      GO,                 (* NUMBER OF GOTO STMT IN PROGRAM *)
011672  0   196      REPSIMT,            (* REPEAT STMTS IN PROGRAM *)
011672  0   197      WHISIMT,            (* WHILE STMTS IN PROGRAM *)
011672  0   198      TOTALCOMMENTS,      (* LINES OF COMMENTS IN A PROGRAM *)
011672  0   199      MORETHANONE,        (* LINES CONTAINING MORE THAT ONE STMT *)
011672  0   200      VALPARA,            (* VALUE PARAMETERS IN PROGRAM *)
011672  0   201      CODELINES,          (* CODE LINES IN PROGRAM *)
011672  0   202      VARNOTUSED,         (* VARIABLES DECL NOT USED *)
011672  0   203      UNIQUEOPS,          (* UNIQUE OPERATORS IN PROGRAM *)
011672  0   204      NONBLANKLINES:      (* NON BLANK LINES IN PROGRAM *)
011672  0   205              INTEGER;
011721  0   206
011721  0   207      OUTLINE:  INTEGER; (* LINE NUMBER INDEX OF HEADING OUTPUT *)
011722  0   208
011722  0   209      LEFTINDENT,         (* NUMBER LEFT INDENTATIONS MADE FROM REFERENCE *)
011722  0   210      ZEROINDENT,         (* NUMBER ZERO INDENTATIONS MADE FROM REFERENCE *)
011722  0   211      RIGHTINDENT:        (* NUMBER RIGHT INDENTATIONS MADE FROM REFERENCE *)
011722  0   212              INTEGER;
011725  0   213
011725  0   214      STAT:               (* ARRAY THAT IS USED TO DETERMINE PLAGIARISM *)
011725  0   215              ARRAY [MODULENUMBERS,MODULENUMBERS] OF INTEGER;
060145  0   216
060145  0   217      ADDWASDONE,         (* TRUE IF ADD DONE FOR MORESORTS *)
060145  0   218      ENDFLAG:  BOOLEAN; (* NECESSARY FOR PROGRAM TERMINATION *)
060147  0   219
060147  0   220  VALUE
060147  0   221      (* INITIALIZE KEYWORDS FOR SYMBOL TABLE INITIALIZATION *)
060147  0   222
060147  0   223      KEYWORDS = ( ('ABS       ',3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   224                   ('ALFA      ',4,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   225                   ('AND       ',3,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   226                   ('ARCCOS    ',6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   227                   ('ARCSIN    ',6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   228                   ('ARCTAN    ',6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
```

```
060147  0   229                 ('ARCTAN2    *.7.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   230                 ('ARRAY      *.5.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   231                 ('BEGIN      *.5.FALSE.FALSE.NIL.NIL.NIL.FINDBEG).
060147  0   232                 ('BOOLEAN    *.7.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   233                 ('CARD       *.4.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   234                 ('CASE       *.4.TRUE.FALSE.NIL.NIL.NIL.CASEST).
060147  0   235                 ('CHAR       *.4.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   236                 ('CHR        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   237                 ('CLOCK      *.5.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   238                 ('CONST      *.5.FALSE.FALSE.NIL.NIL.NIL.CONDEC).
060147  0   239                 ('COS        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   240                 ('COSH       *.4.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   241                 ('DATE       *.4.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   242                 ('DISPOSE    *.7.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   243                 ('DIV        *.3.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   244                 ('DO         *.2.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   245                 ('DOUBLE     *.6.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   246                 ('DOWNTO     *.6.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   247                 ('DYNAMIC    *.7.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   248                 ('ELSE       *.4.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   249                 ('END        *.3.FALSE.FALSE.NIL.NIL.NIL.FINDEND).
060147  0   250                 ('EOF        *.3.TRUE.FALSE.NIL.NIL.NIL.EOFM).
060147  0   251                 ('EOFS       *.4.TRUE.FALSE.NIL.NIL.NIL.EOFSM).
060147  0   252                 ('EOLN       *.4.TRUE.FALSE.NIL.NIL.NIL.EOLNM).
060147  0   253                 ('EOLNS      *.5.TRUE.FALSE.NIL.NIL.NIL.EOLNSM).
060147  0   254                 ('EOS        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   255                 ('EOSS       *.4.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   256                 ('EXP        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   257                 ('EXPO       *.4.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   258                 ('EXTERN     *.6.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   259                 ('FALSE      *.5.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   260                 ('FILE       *.4.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   261                 ('FOR        *.3.TRUE.FALSE.NIL.NIL.NIL.FORST).
060147  0   262                 ('FORTRAN    *.7.FALSE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   263                 ('FORWARD    *.7.FALSE.FALSE.NIL.NIL.NIL.FWD).
060147  0   264                 ('FUNCTION   *.8.FALSE.FALSE.NIL.NIL.NIL.PROCS).
060147  0   265                 ('GENSORT    *.7.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   266                 ('GET        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   267                 ('GETSEG     *.6.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   268                 ('GETRAN     *.6.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   269                 ('GETRANDOM  *.9.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   270                 ('GOTO       *.4.TRUE.FALSE.NIL.NIL.NIL.GOTOST).
060147  0   271                 ('HALT       *.4.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   272                 ('HIGH       *.4.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   273                 ('IF         *.2.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   274                 ('IN         *.2.TRUE.FALSE.NIL.NIL.NIL.INST).
060147  0   275                 ('INPUT      *.5.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   276                 ('INTEGER    *.7.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   277                 ('LABEL      *.5.FALSE.FALSE.NIL.NIL.NIL.LBLDEC).
060147  0   278                 ('LINELIMIT  *.9.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   279                 ('LOG        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   280                 ('LOG10      *.5.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   281                 ('LOW        *.3.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   282                 ('LN         *.2.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   283                 ('MAXINT     *.6.FALSE.FALSE.NIL.NIL.NIL.DUMMY).
060147  0   284                 ('MESSAGE    *.7.TRUE.FALSE.NIL.NIL.NIL.FUNCS).
060147  0   285                 ('MOD        *.3.TRUE.FALSE.NIL.NIL.NIL.DUMMY).
```

```
060147  0   286                 ('NEW         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   287                 ('NIL         *,3,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   288                 ('NOT         *,3,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   289                 ('OCT         *,3,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   290                 ('ODD         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   291                 ('OF          *,2,FALSE,FALSE,NIL,NIL,NIL,FINLOF),
060147  0   292                 ('OR          *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   293                 ('ORD         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   294                 ('OTHERWISE   *,9,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   295                 ('OUTPUT      *,6,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   296                 ('PACK        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   297                 ('PACKED      *,6,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   298                 ('PAGE        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   299                 ('POWER       *,5,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   300                 ('POWER1      *,6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   301                 ('PRED        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   302                 ('PROCEDURE   *,9,FALSE,FALSE,NIL,NIL,NIL,PROCS),
060147  0   303                 ('PROGRAM     *,7,FALSE,FALSE,NIL,NIL,NIL,PROG),
060147  0   304                 ('PUT         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   305                 ('PUTSEG      *,6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   306                 ('RAN         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   307                 ('RANDOM      *,6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   308                 ('READ        *,4,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   309                 ('READLN      *,6,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   310                 ('READSTRING  *,10,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   311                 ('REAL        *,4,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   312                 ('RELEASE     *,7,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   313                 ('RECORD      *,6,FALSE,FALSE,NIL,NIL,NIL,RECDEC),
060147  0   314                 ('REPEAT      *,6,TRUE,FALSE,NIL,NIL,NIL,REPST),
060147  0   315                 ('RESET       *,5,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   316                 ('REWRITE     *,7,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   317                 ('ROUND       *,5,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   318                 ('SEGMENTED   *,9,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   319                 ('SET         *,3,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   320                 ('SETRAN      *,6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   321                 ('SETRANDOM   *,9,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   322                 ('SKIPBLANKS  *,10,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   323                 ('SIN         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   324                 ('SINH        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   325                 ('SQR         *,3,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   326                 ('SQRT        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   327                 ('SUCC        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
060147  0   328                 ('TAN         *,3,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   329                 ('TANH        *,4,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
0601..  0   330                 ('TEXT        *,4,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
0601..  0   331                 ('THEN        *,4,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
0601..  0   332                 ('TIME        *,4,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
0601..  0   333                 ('TO          *,2,FALSE,FALSE,NIL,NIL,NIL,TOST),
0601..  0   334                 ('TRUE        *,4,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
0601..  0   335                 ('TRUNC       *,5,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
0601..  0   336                 ('TYPE        *,4,FALSE,FALSE,NIL,NIL,NIL,TYPDEC),
0601..  0   337                 ('UNPACK      *,6,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
0601..  0   338                 ('UNTIL       *,5,FALSE,FALSE,NIL,NIL,NIL,DUMMY),
0601..  0   339                 ('UNDEFINED   *,9,TRUE,FALSE,NIL,NIL,NIL,FUNCS),
0601..  0   340                 ('VALUE       *,5,FALSE,FALSE,NIL,NIL,NIL,VALDEC),
0601..  0   341                 ('VAR         *,3,FALSE,FALSE,NIL,NIL,NIL,VARDEC),
0601..  0   342                 ('WHILE       *,5,TRUE,FALSE,NIL,NIL,NIL,WHIST),
```

```
060147  0   343                     (*WITH      *,4,TRUE,FALSE,NIL,NIL,NIL,WITHST),
060147  0   344                     (*WRITE     *,5,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   345                     (*WRITELN   *,7,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   346                     (*+         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   347                     (*-         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   348                     (**         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   349                     (*)         *,2,FALSE,FALSE,NIL,NIL,NIL,ANY),
060147  0   350                     (*/         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   351                     (*(         *,1,FALSE,FALSE,NIL,NIL,NIL,LPAR),
060147  0   352                     (*)         *,1,FALSE,FALSE,NIL,NIL,NIL,RPAR),
060147  0   353                     (*$         *,1,FALSE,FALSE,NIL,NIL,NIL,ANY),
060147  0   354                     (*=         *,1,TRUE,FALSE,NIL,NIL,NIL,EQUAL),
060147  0   355                     (*,         *,1,TRUE,FALSE,NIL,NIL,NIL,COMMA),
060147  0   356                     (*..        *,2,TRUE,FALSE,NIL,NIL,NIL,ELLIPSIS),
060147  0   357                     (*.         *,1,TRUE,FALSE,NIL,NIL,NIL,TERMINAL),
060147  0   358                     (*[         *,1,TRUE,FALSE,NIL,NIL,NIL,LBRAC),
060147  0   359                     (*]         *,1,FALSE,FALSE,NIL,NIL,NIL,RBRAC),
060147  0   360                     (*:         *,1,FALSE,FALSE,NIL,NIL,NIL,COLON),
060147  0   361                     (*:=        *,2,TRUE,FALSE,NIL,NIL,NIL,ASSIGN),
060147  0   362                     (*<         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   363                     (*>         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   364                     (*<>        *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   365                     (*;         *,1,FALSE,FALSE,NIL,NIL,NIL,SEMI),
060147  0   366                     (*<=        *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   367                     (*>=        *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   368                     (*          *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   369                     (*#         *,1,FALSE,FALSE,NIL,NIL,NIL,ANY),
060147  0   370                     (*&         *,1,FALSE,FALSE,NIL,NIL,NIL,ANY),
060147  0   371                     (*?         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   372                     (*          *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   373                     (*'         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   374                     (*'.        *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   375                     (*"         *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   376                     (*" .       *,2,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   377                     (*          *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY),
060147  0   378                     (*          *,1,TRUE,FALSE,NIL,NIL,NIL,DUMMY) );
060147  0   379         (* END KEYWORDS *)
060147  0   380
060147  0   381
060147  0   382
060147  0   383  PROCEDURE SCANNER;
000002  0   384  FORWARD;
000002  0   385
000002  0   386
000002  0   387
000002  0   388  PROCEDURE GETLINE;
000002  0   389  FORWARD;
000002  0   390
000002  0   391
000002  0   392
000002  0   393  PROCEDURE DRIVER;
000002  0   394  FORWARD;
000002  0   395
000002  0   396
000002  0   397
000002  0   398  PROCEDURE COUNT (COUNTER:COUNTCLASS);
000003  0   399  FORWARD;
```

```
000001  0   400
000001  0   401
000001  0   402
000001  0   403  PROCEDURE MODINIT;
000002  0   404  FORWARD;
000002  0   405
000002  0   406
000002  0   407
000002  0   408  PROCEDURE EXITNMBR;
000002  0   409  FORWARD;
000002  0   410
000002  0   411
000002  0   412
000002  0   413  PROCEDURE EXITPROCEDURE;
000002  0   414  FORWARD;
000002  0   415
000002  0   416
000002  0   417
000002  0   418  PROCEDURE INSERT;
000002  0   419     (* INSERT KEYWORDS INTO THE SYMBOL TABLE *)
000002  0   420
000002  0   421  VAR
000002  0   422      BUFF:       CHBUFF;
000014  0   423
000014  0   424  BEGIN (* INSERT *)
000014  1   425
000014  1   426  UNPACK (PTRNEWREC^.STRING.BUFF,1);
000014  1   427  IF  SYMTBL[BUFF[1]] <> NIL
000018  1   428  THEN  SYMTBL[BUFF[1]] := PTRNEWREC
000022  1   429  ELSE  BEGIN
000024  2   430        PTRSYMTBL := SYMTBL[BUFF[1]];
000027  2   431        WHILE  PTRSYMTBL^.NEXTSYM <> NIL  DO
000035  2   432               PTRSYMTBL := PTRSYMTBL^.NEXTSYM;
000043  2   433        PTRSYMTBL^.NEXTSYM := PTRNEWREC;
000050  2   434        PTRNEWREC^.LASTSYM := PTRSYMTBL;
000055  2   435        END;
000055  1   436
000055  1   437  END;  (* INSERT *)
000057  0   438
000057  0   439
000057  0   440
000057  0   441  PROCEDURE SYMINIT;
000002  0   442     (* INITIALIZE THE SYMBOL TABLE *)
000002  0   443
000002  0   444  VAR
000002  0   445      C:          CHAR;
000003  0   446      I:          INTEGER;
000004  0   447
000004  0   448  BEGIN (* SYMINIT *)
000004  1   449
000004  1   450  FOR C := CHR(0) TO CHR(MAXCHAR) DO
000007  1   451      SYMTBL[C] := NIL;
000020  1   452
000020  1   453  FOR I := 1 TO NUMKEYWORDS DO
000021  1   454      BEGIN
000023  2   455      NEW (PTRNEWREC);
000025  2   456      PTRNEWREC^ := KEYWORDS[I];
```

```
000040  2   457      INSERT;
000041  2   458      END;
000046  1   459
000046  1   460  END;  (* SYMINIT *)
000054  0   461
000054  0   462
000054  0   463
000054  0   464  PROCEDURE SCANINIT;
000002  0   465      (* INITIALIZE THE SCANNER *)
000002  0   466
000002  0   467  VAR
000002  0   468      C:        CHAR;
000003  0   469
000003  0   470  BEGIN (* SCANINIT *)
000003  1   471
000003  1   472  FOR C := CHR(0) TO CHR(MAXCHAR) DO
000007  1   473      CHTBL[C] := 12;
000020  1   474
000020  1   475  CHTBL["0"] :=  0;
000021  1   476  CHTBL["1"] :=  1;
000022  1   477  CHTBL["2"] :=  2;
000023  1   478  CHTBL["3"] :=  3;
000025  1   479  CHTBL["4"] :=  4;
000028  1   480  CHTBL["5"] :=  5;
000030  1   481  CHTBL["6"] :=  6;
000031  1   482  CHTBL["7"] :=  7;
000033  1   483  CHTBL["8"] :=  8;
000034  1   484  CHTBL["9"] :=  9;
000036  1   485  CHTBL["A"] := 10;
000037  1   486  CHTBL["B"] := 10;
000041  1   487  CHTBL["C"] := 10;
000042  1   488  CHTBL["D"] := 10;
000044  1   489  CHTBL["E"] := 10;
000045  1   490  CHTBL["F"] := 10;
000047  1   491  CHTBL["G"] := 10;
000[..]  1   492  CHTBL["H"] := 10;
000[..]  1   493  CHTBL["I"] := 10;
000[..]  1   494  CHTBL["J"] := 10;
000[..]  1   495  CHTBL["K"] := 10;
000[..]  1   496  CHTBL["L"] := 10;
000[..]  1   497  CHTBL["M"] := 10;
000[..]  1   498  CHTBL["N"] := 10;
000063  1   499  CHTBL["O"] := 10;
000064  1   500  CHTBL["P"] := 10;
000[..]  1   501  CHTBL["Q"] := 10;
000[..]  1   502  CHTBL["R"] := 10;
000[..]  1   503  CHTBL["S"] := 10;
000[..]  1   504  CHTBL["T"] := 10;
000[..]  1   505  CHTBL["U"] := 10;
000075  1   506  CHTBL["V"] := 10;
000[..]  1   507  CHTBL["W"] := 10;
000[..]  1   508  CHTBL["X"] := 10;
000[..]  1   509  CHTBL["Y"] := 10;
000[..]  1   510  CHTBL["Z"] := 10;
000[..]  1   511  CHTBL[QUOTE] := 11;
000[..]  1   512
000[..]  1   513  END; (* SCANINIT *)
```

```
000112  0   514
000112  0   515
000112  0   516
000112  0   517 PROCEDURE DUMPSYMTBL;
000002  0   518    (* DUMP THE CURRENT CONTENTS OF THE SYMBOL TABLE.
000002  0   519       THE FOLLOWING VALUES ARE DUMPED:
000002  0   520           STRING
000002  0   521           OP
000002  0   522           USED *)
000002  0   523
000002  0   524  VAR  C: CHAR;
000003  0   525
000003  0   526  BEGIN (* DUMPSYMTBL *)
000003  1   527
000003  1   528  WRITELN ("1");
000012  1   529  FOR  C := CHR(0) TO CHR(MAXCHAR)  DO
000015  1   530       IF  SYMTBL[C] <> NIL
000022  1   531       THEN  BEGIN
000024  2   532             WRITELN("0");
000032  2   533             PTRSYMTBL := SYMTBL[C];
000036  2   534             WHILE  PTRSYMTBL <> NIL  DO
000041  2   535                    WITH  PTRSYMTBL^  DO
000045  2   536                          BEGIN
000045  3   537                          WRITE (" KEYWORD = ",STRING:10);
000057  3   538                          WRITE ("     OP = ", OP:5);
000070  3   539                          WRITELN ("     USED = ", USED:5);
000102  3   540                          PTRSYMTBL := NEXTSYM;
000125  3   541                          END;
000106  2   542             END;
000113  1   543
000113  1   544  END;  (* DUMPSYMTBL *)
000124  0   545
000124  0   546
000124  0   547
000124  0   548  PROCEDURE ABORT;
000002  0   549     (* ABORT THE PRESENT PROGRAM-
000002  0   550        IT IS UNCOMPILEABLE *)
000002  0   551
000002  0   552  VAR   I:   INTEGER;
000003  0   553
000003  0   554  BEGIN (* ABORT *)
000003  1   555
000003  1   556  EXITNMBR;
000005  1   557  WHILE  NESTLEVEL > 0  DO
000007  1   558         EXITPROCEDURE;
000011  1   559  COUNT (UNOPS);
000015  1   560  WHILE  (ACTION <> TERM) AND (ENDFLAG <> TRUE)  DO
000022  1   561         BEGIN
000022  2   562         NEWLINE := FALSE;
000023  2   563         SCANNER;
000024  2   564         END;
000025  1   565  (* INSERT THE LINENUMBER WHERE THE ABORT OCCURRED *)
000025  1   566  PROGNOSIS[MODULE.1] := TOTALLINES;
000033  1   567  FOR I := 2 TO PARACOUNT DO
000034  1   568     PROGNOSIS[MODULE.I] := 0;
000050  1   569  MODINIT;
000051  1   570
```

```
000051  1    571  END;  (* ABORT *)
000055  0    572
000055  0    573
000055  0    574
000055  0    575  FUNCTION TEST: BOOLEAN;
000003  0    576     (* SEE IF THE INPUT STRING IS A KEYWORD
000003  0    577        ON ENTRY-
000003  0    578           IDENBUFF[1..ENDIDEN] = STRING TO BE CHECKED
000003  0    579        ON EXIT-
000003  0    580           IF STRING IS NOT A KEYWORD THEN TEST = FALSE
000003  0    581           IF STRING IS A KEYWORD THEN TEST = TRUE *)
000003  0    582
000003  0    583  LABEL 1,2;
000003  0    584
000003  0    585  VAR   BUFF: CHBUFF;
000015  0    586        I:    TEXTNDX;
000016  0    587
000016  0    588  BEGIN (* TEST *)
000016  1    589
000016  1    590  TEST := FALSE;
000010  1    591  PTRSYMTBL := SYMTBL[IDENBUFF[1]];
000014  1    592  WHILE  PTRSYMTBL <> NIL  DO
000017  1    593         BEGIN
000017  2    594         IF  ENDIDEN = PTRSYMTBL^.LNGTH
000023  2    595         THEN  WITH PTRSYMTBL^ DO
000031  2    596                     BEGIN
000031  3    597                     UNPACK (STRING.BUFF,1);
000035  3    598                     FOR I := 1 TO ENDIDEN DO
000037  3    599                         IF  IDENBUFF[I] <> BUFF[I]
000047  3    600                         THEN  GOTO 1;
000057  3    601                     TEST := TRUE;
000060  3    602                     GOTO 2;
000061  3    603                     END;
000061  2    604         1:  PTRSYMTBL := PTRSYMTBL^.NEXTSYM;
000067  2    605         END;
000070  1    606
000070  1    607  2: END; (* TEST *)
000075  0    608
000075  0    609
000075  0    610
000075  0    611  PROCEDURE GETLINE;
000002  0    612     (* READ A LINE OF TEXT INTO A BUFFER
000002  0    613        ON EXIT-
000002  0    614           LINE[1] = FIRST CHARACTER OF THE LINE
000002  0    615           INDEX = 1
000002  0    616           LINE[ENDLINE] = QUOTE TO TERMINATE LINE
000002  0    617           ALL BLANKS REMAIN IN THE LINE *)
000002  0    618
000002  0    619  VAR  I:  INTEGER;
000003  0    620
000003  0    621  BEGIN (* GETLINE *)
000003  1    622
000003  1    623  IF  EOP
000004  1    624  THEN  BEGIN
000006  2    625        ACTION := ENDLIST;
000007  2    626        KEYWORD := FALSE;
000011  2    627        YES := FALSE;
```

```
000012  2   628         DRIVER;
000013  2   629         END
000013  1   630  ELSE   BEGIN
000014  2   631         ENDLINE := 1;
000016  2   632         WHILE  (NOT EOLN) AND (ENDLINE < LNLIM)  DO
000021  2   633                BEGIN
000021  3   634                READ (LINE[ENDLINE]);
000030  3   635                ENDLINE := ENDLINE + 1;
000034  3   636                END;
000035  2   637         READLN;
000037  2   638         INDEX := 1;
000041  2   639         LINE[ENDLINE] := QUOTE;
000045  2   640         NEWLINE := TRUE;
000046  2   641         SAMELINE := FALSE;
000050  2   642         END;
000050  1   643
000050  1   644  COUNT (EPLIN);
000053  1   645
000053  1   646  END;  (* GETLINE *)
000057  0   647
000057  0   648
000057  0   649
000057  0   650  PROCEDURE SCANNER;
000002  0   651     (* OBTAIN THE NEXT TOKEN FROM THE INPUT LINE AND PASS IT TO THE DRIVER
000002  0   652        ON ENTRY-
000002  0   653           LINE[INDEX] = FIRST UNEXAMINED CHAR
000002  0   654           LINE[ENDLINE] = QUOTE ACTING AS LINE TERMINATOR
000002  0   655        ON EXIT-
000002  0   656           TOKTYP DESCRIBES THE TOKEN OBTAINED
000002  0   657           IF KEYWORD = FALSE THEN ACTION CONTAINS TOKTYP
000002  0   658           IF KEYWORD = TRUE THEN PTRSYMBL^.TOK CONTAINS TOKTYP.
000002  0   659        THIS SCANNER IS A MODIFICATION OF THE PASCAL6 COMPILER SCANNER
000002  0   660        WRITTEN AT THE UNIVERSITY OF COLORADO *)
000002  0   661
000002  0   662
000002  0   663            PROCEDURE IDENTIFIER;
000002  0   664               (* EXTRACT AN IDENTIFIER OR KEYWORD FROM THE INPUT LINE
000002  0   665                  ON ENTRY-
000002  0   666                     LINE[INDEX] CONTAINS A LETTER
000002  0   667                  ON EXIT-
000002  0   668                     LINE[INDEX] CONTAINS THE CHARACTER FOLLOWING THE IDENTIFIER
000002  0   669                     IF KEYWORD = FALSE THEN WE HAVE AN IDENTIFIER AND ACTION
000002  0   670                     CONTAINS TOKTYP
000002  0   671                     IF KEYWORD = TRUE THEN WE HAVE A KEYWORD AND PTRSYMBL^.TOK
000002  0   672                     CONTAINS TOKTYP *)
000002  0   673
000002  0   674            BEGIN (* IDENTIFIER *)
000002  1   675
000002  1   676            IDENBUFF[1] := LINE[INDEX];
000001  1   677            ENDIDEN := 1;
000001  1   678            INDEX := INDEX + 1;
000001  1   679            WHILE  CHTPL[LINE[INDEX]] < 11  DO
000002  1   680                   BEGIN
000002  2   681                   ENDIDEN := ENDIDEN + 1;
000002  2   682                   IDENBUFF[ENDIDEN] := LINE[INDEX];
000003  2   683                   INDEX := INDEX + 1;
000003  2   684                   END;
```

```
000043  1   685            IF  ENDIDEN > 10
000043  1   686            THEN  ENDIDEN := 10;
000047  1   687            KEYWORD := TEST;
000053  1   688            IF  NOT KEYWORD
000053  1   689            THEN  ACTION := OPND
000054  1   690            ELSE  ACTION := PTRSYMTBL^.TOK;
000066  1   691            NEWLINE := FALSE;
000070  1   692
000070  1   693            END;  (* IDENTIFIER *)
000072  0   694
000072  0   695
000072  0   696            PROCEDURE NUMBER;
000002  0   697               (* EXTRACT A NUMBER FROM THE INPUT LINE
000002  0   698                  ON ENTRY-
000002  0   699                     LINE[INDEX] CONTAINS A DIGIT
000002  0   700                  ON EXIT-
000002  0   701                     LINE[INDEX] CONTAINS THE CHARACTER FOLLOWING THE NUMBER
000002  0   702                     ACTION CONTAINS TOKTYP *)
000002  0   703
000002  0   704                  PROCEDURE SCANDIG;
000002  0   705                     (* SCANNER FOR A DIGIT STRING *)
000002  0   706
000002  0   707                  BEGIN (* SCANDIG *)
000002  1   708
000002  1   709                  WHILE  CHTBL[LINE[INDEX]] < 10  DO
000013  1   710                         BEGIN
000013  2   711                         ENDIDEN := ENDIDEN + 1;
000017  2   712                         IDENBUFF[ENDIDEN] := LINE[INDEX];
000025  2   713                         INDEX := INDEX + 1;
000030  2   714                         END;
000031  1   715
000031  1   716                  END;  (* SCANDIG *)
000033  0   717
000033  0   718            BEGIN (* NUMBER *)
000033  1   719
000033  1   720            IDENBUFF[1] := LINE[INDEX];
000012  1   721            INDEX := INDEX + 1;
000015  1   722            ENDIDEN := 1;
000016  1   723            SCANDIG;
000020  1   724            IF  (LINE[INDEX] = '.') AND (CHTBL[LINE[INDEX + 1]] < 10)
000032  1   725            THEN  BEGIN
000033  2   726                  ENDIDEN := ENDIDEN + 1;
000037  2   727                  IDENBUFF[ENDIDEN] := LINE[INDEX];
000046  2   728                  INDEX := INDEX + 1;
000050  2   729                  SCANDIG;
000052  2   730                  END;
000052  1   731            IF  LINE[INDEX] = 'E'
000055  1   732            THEN  BEGIN
000057  2   733                  ENDIDEN := ENDIDEN + 1;
000063  2   734                  IDENBUFF[ENDIDEN] := 'E';
000066  2   735                  INDEX := INDEX + 1;
000071  2   736                  IF  (LINE[INDEX] = '+') OR (LINE[INDEX] = '-')
000077  2   737                  THEN  BEGIN
000101  3   738                        ENDIDEN := ENDIDEN + 1;
000104  3   739                        IDENBUFF[ENDIDEN] := LINE[INDEX];
000113  3   740                        INDEX := INDEX + 1;
000116  3   741                        END;
```

```
000118  2   742                 SCANDIG;
000128  2   743                 END;
000120  1   744             IF  ENDIDEN > 10
000120  1   745             THEN  ENDIDEN := 10;
000124  1   746             ACTION := NMBR;
000126  1   747             NEWLINE := FALSE;
000127  1   748
000127  1   749             END;  (* NUMBER *)
000131  0   750
000131  0   751             PROCEDURE STRING;
000002  0   752                (* EXTRACT A STRING FROM THE INPUT LINE
000002  0   753                   ON ENTRY-
000002  0   754                      LINE[INDEX] = QUOTE
000002  0   755                      LINE[ENDLINE] = QUOTE ACTING AS LINE TERMINATOR
000002  0   756                      INDEX < ENDLINE
000002  0   757                   ON EXIT-
000002  0   758                      LINE[INDEX] CONTAINS THE CHARACTER FOLLOWING THE STRING
000002  0   759                      ACTION CONTAINS TOKTYP *)
000002  0   760
000002  0   761                    PROCEDURE SCANSEG;
000002  0   762                       (* SCANNER FOR A SEGMENT OF A STRING *)
000002  0   763
000002  0   764                    BEGIN (* SCANSEG *)
000002  1   765
000002  1   766                    INDEX := INDEX + 1;
000010  1   767                    WHILE  LINE[INDEX] <> QUOTE  DO
000015  1   768                           INDEX := INDEX + 1;
000020  1   769                    IF  INDEX < ENDLINE
000020  1   770                    THEN  INDEX := INDEX + 1
000022  1   771                    ELSE  ABORT;
000026  1   772
000026  1   773                    END;  (* SCANSEG *)
000030  0   774
000030  0   775             BEGIN (* STRING *)
000030  1   776
000030  1   777             SCANSEG;
000006  1   778             WHILE  (INDEX < ENDLINE) AND (LINE[INDEX] = QUOTE)  DO
000015  1   779                    SCANSEG;
000017  1   780             ACTION := OPND;
000021  1   781             NEWLINE := FALSE;
000023  1   782
000...  1   783             END;  (* STRING *)
0000..  0   784
000024  0   785             PROCEDURE DELIMITER;
000002  0   786                (* EXTRACT A DELIMITER FROM THE INPUT LINE
000002  0   787                   ON ENTRY-
00000.  0   788                      LINE[INDEX] CONTAINS THE FIRST CHARACTER OF THE DELIMITER
0000..  0   789                      INDEX < ENDLINE
0000..  0   790                   ON EXIT-
0000..  0   791                      LINE[INDEX] CONTAINS THE CHARACTER FOLLOWING THE DELIMITER
00000.  0   792                      SYMBL.TOK CONTAINS TOKTYP *)
00000.  0   793
00000.  0   794                    PROCEDURE COMMENT;
00000.  0   795                       (* PROCESS A COMMENT
00000.  0   796                          ON ENTRY-
0000..  0   797                             LINE[INDEX..INDEX+1] = ..
0000..  0   798                          ON EXIT-
```

```
000002  0   799                         LINE[INDEX] = CHARACTER FOLLOWING THE COMMENT *)
000002  0   800
000002  0   801                 LABEL 1;
000002  0   802
000002  0   803                 BEGIN (* COMMENT *)
000002  1   804
000002  1   805                 LINESOFCOMMENT := 0;
000006  1   806                 INDEX := INDEX + 2;
000012  1   807                 LINE[ENDLINE] := "*";
000015  1   808                 WHILE  TRUE  DO
000017  1   809                       BEGIN
000017  2   810                       WHILE  LINE[INDEX] <> "*"  DO
000024  2   811                              INDEX := INDEX + 1;
000027  2   812                       IF  INDEX < ENDLINE
000027  2   813                       THEN  BEGIN
000031  3   814                             INDEX := INDEX + 1;
000033  3   815                             IF  LINE[INDEX] = ")"
000035  3   816                             THEN  BEGIN
000037  4   817                                   LINE[ENDLINE] := QUOTE;
000042  4   818                                   LINESOFCOMMENT := LINESOFCOMMENT + 1;
000044  4   819                                   INDEX := INDEX + 1;
000047  4   820                                   GOTO 1;
000050  4   821                                   END;
000050  3   822                             END
000050  2   823                       ELSE  BEGIN
000051  3   824                             LINESOFCOMMENT := LINESOFCOMMENT + 1;
000053  3   825                             GETLINE;
000054  3   826                             LINE[ENDLINE] := "*";
000060  3   827                             END;
000060  2   828                        END;
000061  1   829                 1: ACTION := COMNT;
000063  1   830                 NEWLINE := FALSE;
000064  1   831
000064  1   832                 END;  (* COMMENT *)
000066  0   833
000066  0   834           BEGIN (* DELIMITER *)
000066  1   835
000066  1   836           IF  (LINE[INDEX] = "(") AND (LINE[INDEX + 1] = "*")
000014  1   837           THEN  COMMENT
000015  1   838           ELSE  BEGIN
000020  2   839                 ISADELIMITER := TRUE;
000022  2   840                 IDENBUFF[1] := LINE[INDEX];
000027  2   841                 IDENBUFF[2] := LINE[INDEX + 1];
000033  2   842                 ENDIDEN := 2;
000035  2   843                 KEYWORD := TEST;
000041  2   844                 IF  KEYWORD
000041  2   845                 THEN  INDEX := INDEX + 2
000042  2   846                 ELSE  BEGIN
000046  3   847                       ENDIDEN := 1;
000050  3   848                       KEYWORD := TEST;
000054  3   849                       INDEX := INDEX + 1;
000057  3   850                       END;
000057  2   851                 ACTION := PTRSYMBL^.TOK;
000067  2   852                 END;
000067  1   853           NEWLINE := FALSE;
000071  1   854
000071  1   855           END;  (* DELIMITER *)
```

```
000073  0   856
000073  0   857            PROCEDURE BLANKS;
000002  0   858               (* EXTRACT ONE OR MORE BLANKS FROM THE INPUT LINE
000002  0   859                  ON EXIT-
000002  0   860                     LINE[INDEX] POINTS TO THE FIRST CHARACTER FOLLOWING
000002  0   861                     THE BLANK(S)
000002  0   862                     ACTION CONTAINS TOKTYP *)
000002  0   863
000002  0   864            BEGIN (* BLANKS *)
000002  1   865
000002  1   866            NUMBLNKS := 0;
000005  1   867            WHILE  LINE[INDEX] = ' '  DO
000013  1   868                   BEGIN
000013  2   869                   NUMBLNKS := NUMBLNKS + 1;
000015  2   870                   INDEX := INDEX + 1;
000017  2   871                   END;
000020  1   872            ACTION := BLNKS;
000022  1   873
000022  1   874            END;  (* BLANKS *)
000024  0   875
000024  0   876  BEGIN (* SCANNER *)
000024  1   877
000024  1   878  KEYWORD := FALSE;
000026  1   879  ISADELIMITER := FALSE;
000027  1   880  IF  (NOT NEWLINE) AND (INDEX = ENDLINE)
000031  1   881  THEN  GETLINE;
000034  1   882  IF NEWLINE
000034  1   883  THEN  BLANKS
000036  1   884  ELSE  IF  LINE[INDEX] = ' '
000043  1   885        THEN  BLANKS
000045  1   886        ELSE  CASE CHTBL[LINE[INDEX]] OF
000035  2   887                    0,1,2,3,4,5,6,7,8,9:  NUMBER;
000040  2   888                    10:  IDENTIFIER;
000043  2   889                    11:  STRING;
000046  2   890                    12:  DELIMITER;
000051  2   891              END; (* CASE *)
000063  1   892
000063  1   893  END;  (* SCANNER *)
000065  0   894
000065  0   895
000065  0   896
000065  0   897  PROCEDURE ACCUSEINIT;
000002  0   898     (* INITIALIZE VARIABLES FOR ACCUSE *)
000002  0   899
000002  0   900  VAR   I,J:   INTEGER;
000003  0   901
000004  0   902  BEGIN (* ACCUSEINIT *)
000004  1   903
000004  1   904  (* INITIALIZE STAT FOR ACCUSE STP *)
000004  1   905  FOR I := 1 TO MAXMODULE DO
000006  1   906      FOR J := 1 TO MAXMODULE DO
000012  1   907          STAT[I,J] := 0;
000031  1   908
000031  1   909  (* INITIALIZE ORDER FOR SORTPROGNOSIS *)
000031  1   910  FOR I := 1 TO MAXMODULE DO
000032  1   911      ORDER[I] := 1;
000044  1   912
```

```
000044  1   913  (* INITIALIZE MODULE *)
000044  1   914  MODULE := 0;
000045  1   915
000045  1   916  (* INITIALIZE HEAD OF NMBR LIST *)
000045  1   917  HEADNMBR := NIL;
000047  1   918
000047  1   919  ADDWASDONE := FALSE;
000050  1   920
000050  1   921  MODINIT;
000051  1   922
000051  1   923  END;  (* ACCUSEINIT *)
000057  0   924
000057  0   925
000057  0   926
000057  0   927  PROCEDURE MODINIT;
000002  0   928     (* INITIALIZE VARIABLES FOR EACH MODULE *)
000002  0   929
000002  0   930
000002  0   931  BEGIN (* MODINIT *)
000002  1   932
000002  1   933  MODULE := MODULE + 1;
000010  1   934  STARTPOS      := 0;
000011  1   935  LEFTINDENT    := 0;
000013  1   936  ZEROINDENT    := 0;
000014  1   937  RIGHTINDENT   := 0;
000015  1   938  NUMBLNKS      := 0;
000016  1   939  NUMREG        := 0;
000020  1   940  NUMCASE       := 0;
000021  1   941  AMTFWDDEC     := 0;
000022  1   942
000022  1   943  TOTALLINES        := 0;
000023  1   944  OPERATORS         := 0;
000024  1   945  CONSANDTYPES      := 0;
000025  1   946  UNIQUEOPN         := 0;
000026  1   947  VARIABLES         := 0;
000027  1   948  VARPARA           := 0;
000030  1   949  PROVAR            := 0;
000031  1   950  PROCANDFUNC       := 0;
000032  1   951  OPERANDS          := 0;
000033  1   952  FORSTMT           := 0;
000034  1   953  GO                := 0;
000035  1   954  REPSTMT           := 0;
000036  1   955  WHISTMT           := 0;
000037  1   956  TOTALCOMMENTS     := 0;
000040  1   957  MORETHANONE       := 0;
000041  1   958  VALPARA           := 0;
000042  1   959  CODELINES         := 0;
000043  1   960  VARNOTUSED        := 0;
000044  1   961  UNIQUEOPS         := 0;
000045  1   962
000045  1   963  YES               := TRUE;
000047  1   964  ENDFLAG           := FALSE;
000050  1   965  PARADEC           := FALSE;
000052  1   966  PRODECL           := FALSE;
000053  1   967  FWDDEC            := FALSE;
000054  1   968  PRODECLNOTUSED[MODULE]   := FALSE;
000057  1   969
```

```
000057  1   970  IF  NOT EOF
000057  1   971  THEN  GETLINE;
000061  1   972
000061  1   973  END;  (* MODINIT *)
000063  0   974
000063  0   975
000063  0   976
000063  0   977  PROCEDURE COUNTUNOPS;
000002  0   978     (* TRAVERSE THE SYMBOL TABLE.  IF USED = TRUE THEN INCREMENT UNIQUEOPS *)
000002  0   979
000002  0   980  VAR  C:   CHAR;
000003  0   981
000003  0   982  BEGIN (* COUNTUNOPS *)
000003  1   983
000003  1   984  FOR C := CHR(0) TO CHR(MAXCHAR) DO
000007  1   985      BEGIN
000013  2   986      PTRSYMTBL := SYMTBL[C];
000016  2   987      WHILE  PTRSYMTBL <> NIL  DO
000021  2   988             WITH  PTRSYMTBL^  DO
000025  2   989                   BEGIN
000025  3   990                   IF  USED
000025  3   991                   THEN  BEGIN
000027  4   992                         UNIQUEOPS := UNIQUEOPS + 1;
000031  4   993                         USED := FALSE;
000032  4   994                         END;
000032  3   995                   PTRSYMTBL := NEXTSYM;
000035  3   996                   END;
000036  2   997      END;
000043  1   998
000043  1   999  END;  (* COUNTUNOPS *)
000047  0  1000
000047  0  1001
000047  0  1002
000047  0  1003  PROCEDURE DECLARE;
000002  0  1004     (* PUT DECLARED VARIABLES INTO THE DECLIST AT THE APPROPRIATE NESTLEVEL *)
000002  0  1005
000002  0  1006  VAR      I:         INTEGER;
000003  0  1007
000003  0  1008  BEGIN (* DECLARE *)
000003  1  1009
000003  1  1010  IF  NESTLEVEL > 1
000004  1  1011  THEN  COUNT (PRVAR);
000012  1  1012  NEW (PTRNEWREC);
000014  1  1013  WITH  PTRNEWREC^  DO
000021  1  1014        BEGIN
000021  2  1015        FOR I := 1 TO ENDIDEN DO
000024  2  1016            STRING[I] := IDENBUFF[I];
000043  2  1017        LNGTH := ENDIDEN;
000045  2  1018        OP := FALSE;
000046  2  1019        USED := FALSE;
000047  2  1020        NEXTSYM := NIL;
000050  2  1021        END;
000050  1  1022  IF  DECLIST^[NESTLEVEL] <> NIL
000053  1  1023  THEN  BEGIN
000055  2  1024        DECLIST[NESTLEVEL]^.LASTSYM := PTRNEWREC;
000065  2  1025        PTRNEWREC^.NEXTSYM := DECLIST[NESTLEVEL];
000073  2  1026        END;
```

```
000073  1  1027  DECLIST[NESTLEVEL] := PTRNEWREC;
000100  1  1028  PTRNEWREC^.LASTSYM := NIL;
000105  1  1029
000105  1  1030  END;  (* DECLARE *)
000111  0  1031
000111  0  1032
000111  0  1033
000111  0  1034  PROCEDURE OPNUSED;
000002  0  1035     (* ON ENTRY-
000002  0  1036           LIST OF VARIABLES DECLARED
000002  0  1037        ON EXIT-
000002  0  1038           LIST OF VARIABLES DECLARED MINUS CURRENT OPERAND *)
000002  0  1039
000002  0  1040  LABEL  1,2;
000002  0  1041
000002  0  1042  VAR    I,J:   INTEGER;
000004  0  1043         PTR:   SYMBLINK;
000005  0  1044         BUFF:  CHBUFF;
000017  0  1045
000017  0  1046  BEGIN (* OPNUSED *)
000017  1  1047
000017  1  1048  FOR I := NESTLEVEL DOWNTO 1 DO
000006  1  1049      BEGIN
000010  2  1050      PTR := DECLIST[I];
000014  2  1051      WHILE  PTR <> NIL  DO
000017  2  1052             BEGIN
000017  3  1053             IF  ENDIDEN = PTR^.LNGTH
000023  3  1054             THEN  WITH  PTR^  DO
000031  3  1055                   BEGIN
000031  4  1056                   UNPACK (STRING.BUFF,1);
000035  4  1057                   FOR J := 1 TO ENDIDEN DO
000037  4  1058                       IF  IDENBUFF[J] <> BUFF[J]
000046  4  1059                       THEN  GOTO 1;
000056  4  1060                   IF  I = 1
000056  4  1061                   THEN  BEGIN
000060  5  1062                         IF  LASTSYM <> NIL
000064  5  1063                         THEN  LASTSYM^.NEXTSYM := NEXTSYM
000067  5  1064                         ELSE  DECLIST[I] := NEXTSYM;
000073  5  1065                         IF  NEXTSYM <> NIL
000077  5  1066                         THEN  NEXTSYM^.LASTSYM := LASTSYM;
000103  5  1067                         DISPOSE (PTR);
000107  5  1068                         END
000111  4  1069                   ELSE  USED := TRUE;
000111  4  1070                   GOTO 2;
000112  4  1071                   END;
000113  3  1072              1: PTR := PTR^.NEXTSYM;
000120  3  1073             END;
000125  2  1074      END;
000125  1  1075  2:
000125  1  1076  END;  (* OPNUSED *)
000130  0  1077
000130  0  1078
000130  0  1079
0001    0  1080  PROCEDURE INSERTTEN (NESTLEVEL:INTEGER);
000001  0  1081     (* INSERTS USER DEFINED FUNCTIONS INTO SYMTBL; ON EXIT FROM THE
000001  0  1082        PARTICULAR NESTLEVEL, THESE FUNCTIONS ARE DECLARED BY EXITPRO-
000001  0  1083        CEDURE *)
```

```
000003  0  1084
000003  0  1085  BEGIN (* INSERTTEMP *)
000003  1  1086
000003  1  1087  IF  HEADTEMP[NESTLEVEL] <> NIL
000007  1  1088  THEN  PTRNEWREC^.NEXTTMP := HEADTEMP[NESTLEVEL];
000020  1  1089  HEADTEMP[NESTLEVEL] := PTRNEWREC;
000025  1  1090  INSERT;
000026  1  1091
000026  1  1092  END;  (* INSERTTEMP *)
000032  0  1093
000032  0  1094
000032  0  1095
000032  0  1096  PROCEDURE REDEF;
000007  0  1097     (*  INSERT THE KEYWORD ONTO A LIST OF REDEFINE' KEYWORDS AND REMOVE THE
000002  0  1098         KEYWORD FROM THE SYMBOL TABLE *)
000032  0  1099
000002  0  1100  BEGIN (* REDEF *)
000002  1  1101
000002  1  1102  PTRSYMTBL^.NEXTTMP := HEADREDEF[NESTLEVEL];
000015  1  1103  HEADREDEF[NESTLEVEL] := PTRSYMTBL;
000020  1  1104  WITH  PTRSYMTBL^  DO
000024  1  1105        BEGIN
000024  2  1106        IF  LASTSYM <> NIL
000025  2  1107        THEN  LASTSYM^.NEXTSYM := NEXTSYM
000033  2  1108        ELSE  SYMTBL[STRING[1]] := NEXTSYM;
000040  2  1109        IF  NEXTSYM <> NIL
000041  2  1110        THEN  NEXTSYM^.LASTSYM := LASTSYM;
000050  2  1111        NEXTSYM := NIL;
000052  2  1112        LASTSYM := NIL;
000   4  2  1113        END;
00    .  1  1114
00    .  1  1115  END;  (* REDEF *)
00    .  0  1116
00    .  0  1117
00    .  0  1118
00    .  0  1119  PROCEDURE EXITPROCEDURE;
00    2  0  1120     (* DECREMENT THE NESTLEVEL AND COUNT THE NUMBER OF VARIABLES AND FUNCTION
000002  0  1121        PARAMETERS DECLARED AND NOT USED IN THE PROCEDURE *)
000002  0  1122
00    3  0  1123  LABEL 1;
000002  0  1124  VAR   PTRVARS:   SYMLINK;
000003  0  1125
000003  0  1126  BEGIN (* EXITPROCEDURE *)
000004  1  1127
000011  1  1128  IF  NESTLEVEL <= 0
000012  1  1129  THEN  GOTO 1;
000006  1  1130
000035  1  1131  (* COUNT VARIABLES DECLARED AND NOT USED *)
000041  1  1132  PTRVARS := DECLIST[NESTLEVEL];
000041  1  1133  WHILE  PTRVARS <> NIL  DO
000041  1  1134        WITH  PTRVARS^  DO
000027  1  1135              BEGIN
000027  2  1136              IF  NOT USED
000034  2  1137              THEN  BEGIN
0000    1  1138                    IF  NOT FWDDEC
0000    1  1139                    THEN  COUNT (VARNU);
0000    1  1140                    IF  NESTLEVEL > 1
```

```
000032  3  1141                    THEN  PROVAR := PROVAR - 1;
000036  3  1142                    END;
000036  2  1143                IF  NEXTSYM = NIL
000037  2  1144                THEN  DECLIST[NESTLEVEL] := NIL
000044  2  1145                ELSE  BEGIN
000046  3  1146                      DECLIST[NESTLEVEL] := NEXTSYM;
000052  3  1147                      NEXTSYM^.LASTSYM := NIL;
000057  3  1148                      END;
000057  2  1149                DISPOSE (PTRVARS);
000061  2  1150                PTRVARS := DECLIST[NESTLEVEL];
000066  2  1151                END;
000067  1  1152
000067  1  1153  (* REINSERT REDEFINED KEYWORDS INTO THE SYMBOL TABLE *)
000067  1  1154  WHILE  HEADREDEF[NESTLEVEL] <> NIL  DO
000074  1  1155         WITH  HEADREDEF[NESTLEVEL]^  DO
000103  1  1156               BEGIN
000103  2  1157               PTRNEWREC := HEADREDEF[NESTLEVEL];
000106  2  1158               INSERT;
000107  2  1159               HEADREDEF[NESTLEVEL] := NEXTTMP;
000114  2  1160               END;
000115  1  1161
000115  1  1162  (* REMOVE USER DEFINED FUNCTIONS FROM THE SYMTBL *)
000115  1  1163  WHILE  HEADTEMP[NESTLEVEL] <> NIL  DO
000122  1  1164         WITH  HEADTEMP[NESTLEVEL]^  DO
000131  1  1165               BEGIN
000131  2  1166               IF  LASTSYM <> NIL
000133  2  1167               THEN  LASTSYM^.NEXTSYM := NEXTSYM
000137  2  1168               ELSE  SYMTBL[STRING[1]] := NIL;
000144  2  1169               IF  NEXTSYM <> NIL
000145  2  1170               THEN  NEXTSYM^.LASTSYM := LASTSYM;
000154  2  1171               IF  USED
000154  2  1172               THEN  UNIQUEOPS := UNIQUEOPS + 1
000156  2  1173               ELSE AMTFWDDEC := AMTFWDDEC - 1;
000163  2  1174               PTRVARS := NEXTTMP;
000165  2  1175               DISPOSE (HEADTEMP[NESTLEVEL]);
000172  2  1176               HEADTEMP[NESTLEVEL] := PTRVARS;
000177  2  1177               END;
000200  1  1178
000200  1  1179  IF  AMTFWDDEC < 0
000200  1  1180  THEN  PRODECLNOTUSED[MODULE] := TRUE;
000205  1  1181  NESTLEVEL := NESTLEVEL - 1;
000212  1  1182  !:
000212  1  1183  FWDDEC := FALSE;
000214  1  1184
000214  1  1185  END;  (* EXITPROCEDURE *)
000220  0  1186
000220  0  1187
000220  0  1188
000220  0  1189  PROCEDURE EXITNMBR;
000002  0  1190     (* COUNT AND REMOVE UNIQUE NUMBERS FROM THE NUMBER LIST *)
000002  0  1191
000002  0  1192  VAR   PTR:   SYMLINK;
000003  0  1193
000003  0  1194  BEGIN (* EXITNMBR *)
000003  1  1195
000003  1  1196  WHILE  HEADNMBR <> NIL  DO
000007  1  1197         BEGIN
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```
000007  2  1198          COUNT (U'OPN1);
000012  2  1199          PTR := HEADNMBR;
000014  2  1200          HEADNMBR := PTR^.NEXTSYM;
000021  2  1201          DISPOSE (PTR);
000023  2  1202          END;
000024  1  1203
000024  1  1204  END;  (* EXITNMBR *)
000030  0  1205
000030  0  1206
000030  0  1207
000030  0  1208  FUNCTION INDENFUNC: INTEGER;
000003  0  1209     (* COMPUTE THE INDENTING FUNCTION *)
000003  0  1210
000003  0  1211
000003  0  1212  BEGIN (* INDENFUNC *)
000003  1  1213
000003  1  1214  INDENFUNC := ((LEFTINDENT  MOD 1000) * 1000000) +
000016  1  1215                ((RIGHTINDENT MOD 1000) * 1000)    +
000025  1  1216                 (ZEROINDENT  MOD 1000);
000033  1  1217
000033  1  1218  END;  (* INDENFUNC *)
000036  0  1219
000036  0  1220
000036  0  1221
000036  0  1222  PROCEDURE INSERTPROGNOSIS;
000002  0  1223     (* INSERT COUNTED PARAMETERS INTO PROGNOSIS *)
000002  0  1224
000002  0  1225  BEGIN (* INSERTPROGNOSIS *)
000002  1  1226
000002  1  1227  PROGNOSIS[MODULE,1]  := TOTALLINES;
000012  1  1228  PROGNOSIS[MODULE,2]  := CODELINES;
000017  1  1229  PROGNOSIS[MODULE,3]  := TOTALCOMMENTS;
000024  1  1230  PROGNOSIS[MODULE,4]  := MORETHAN1ONE;
000030  1  1231  PROGNOSIS[MODULE,5]  := CONSANDTYPES;
000036  1  1232  PROGNOSIS[MODULE,6]  := VARIABLES;
000043  1  1233  PROGNOSIS[MODULE,7]  := VARNOTUSED;
000050  1  1234  PROGNOSIS[MODULE,8]  := PROCANDFUNC;
000055  1  1235  PROGNOSIS[MODULE,9]  := VARPARA;
000061  1  1236  PROGNOSIS[MODULE,10] := VALPARA;
000066  1  1237  PROGNOSIS[MODULE,11] := PROVAR;
000073  1  1238  PROGNOSIS[MODULE,12] := FORSTMT;
000100  1  1239  PROGNOSIS[MODULE,13] := REPSTMT;
000105  1  1240  PROGNOSIS[MODULE,14] := WHISTMT;
000111  1  1241  PROGNOSIS[MODULE,15] := GO;
000116  1  1242  PROGNOSIS[MODULE,16] := UNIQUEOPS;
000123  1  1243  PROGNOSIS[MODULE,17] := UNIQUEOPN;
000130  1  1244  PROGNOSIS[MODULE,18] := OPERATORS;
000135  1  1245  PROGNOSIS[MODULE,19] := OPERANDS;
000142  1  1246  PROGNOSIS[MODULE,20] := INDENFUNC;
000150  1  1247
000150  1  1248  END;  (* INSERTPROGNOSIS *)
000152  0  1249
000152  0  1250
000152  0  1251
000152  0  1252  PROCEDURE MODFINI;
000002  0  1253     (* TERMINATE A MODULE *)
000002  0  1254
```

```
000002  0  1255  BEGIN (* MODFINI *)
000002  1  1256
000002  1  1257  EXITNMBR;
000005  1  1258  EXITPROCEDURE;
000006  1  1259  COUNT (UNDFS);
000011  1  1260  VARIABLES := VARIABLES - VARNOTUSED;
000013  1  1261  UNIQUEOPN  := UNIQUEOPN - VARNOTUSED;
000015  1  1262  CODELINES := CODELINES + MORETHANONE;
000016  1  1263  INSERTPROGNOSIS;
000017  1  1264
000017  1  1265  END;  (* MODFINI *)
000021  0  1266
000021  0  1267
000021  0  1268
000021  0  1269  PROCEDURE SORTPROGNOSIS (L,R:INTEGER);
000004  0  1270     (* SORT PROGNOSIS ON THE DESIRED KEY USING A QUICKSORT. *)
000004  0  1271
000004  0  1272  VAR   PART,    (* NUMBER PARTITIONING ON *)
000004  0  1273        LOW,     (* LEFT POINTER *)
000004  0  1274        HIGH,    (* RIGHT POINTER *)
000004  0  1275        TEMP:    (* TEMPORARY STORAGE *)
000004  0  1276                 INTEGER;
000010  0  1277
000010  0  1278        (* ORDER WILL BE THE ARRAY THAT CONTAINS THE SORTED LIST *)
000010  0  1279
000010  0  1280  BEGIN (* SORTPROGNOSIS *)
000010  1  1281
000010  1  1282        PART := ORDER[(L+R) DIV 2];
000012  1  1283        LOW  := L;
000013  1  1284        HIGH := R;
000014  1  1285        REPEAT  (* PARTITION LIST *)
000014  2  1286                WHILE  (PROGNOSIS[ORDER[LOW].KEY] < PROGNOSIS[PART.KEY]) AND (LOW < R)  DO
000035  2  1287                       (* MOVE RIGHT *)
000035  2  1288                       LOW := LOW + 1;
000037  2  1289                WHILE  (PROGNOSIS[ORDER[HIGH].KEY] > PROGNOSIS[PART.KEY]) AND (HIGH > L)  DO
00[illegible]  2  1290                       (* MOVE LEFT *)
00[illegible]  2  1291                       HIGH := HIGH - 1;
00[illegible]  2  1292                IF  LOW <= HIGH
00[illegible]  2  1293                THEN  BEGIN  (* SWAP *)
00[illegible]  3  1294                      TEMP := ORDER[LOW];
00[illegible]  3  1295                      ORDER[LOW] := ORDER[HIGH];
000[illegible]  3  1296                     ORDER[HIGH] := TEMP;
000102  3  1297                      LOW := LOW + 1;
000[illegible]  3  1298                     HIGH := HIGH - 1;
000[illegible]  3  1299                     END;  (* SWAP *)
000[illegible]  2  1300        UNTIL  LOW > HIGH;
000106  1  1301        IF  L < HIGH
00010[illegible]  1  1302        THEN  SORTPROGNOSIS (L,HIGH);
000[illegible]  1  1303        IF  LOW < R
000112  1  1304        THEN  SORTPROGNOSIS (LOW,R);
000[illegible]  1  1305
000[illegible]  1  1306  END;  (* SORTPROGNOSIS *)
000[illegible]  0  1307
000[illegible]  0  1308
000[illegible]  0  1309
000[illegible]  0  1310  PROCEDURE HEADING (PARAMETER: INTEGER);
0000[illegible]  1  1311     (* PRINT HEADI[illegible] FOR OUTPUT PROGNOSIS *)
```

```
000003  0  1312
000003  0  1313  BEGIN (* HEADINGS *)
000003  1  1314
000003  1  1315  CASE  PARAMETER  OF
000005  2  1316
000005  2  1317        1:  CASE  OUTLINE  OF
000007  3  1318                  1:  WRITE ('      *');
000015  3  1319                  2:  WRITE ('TOTAL *');
000023  3  1320                  3:  WRITE ('LINES *');
000031  3  1321            END;
000040  2  1322
000040  2  1323        2:  CASE  OUTLINE  OF
000042  3  1324                  1:  WRITE ('      *');
000050  3  1325                  2:  WRITE (' CODE *');
000056  3  1326                  3:  WRITE ('LINES *');
000064  3  1327            END;
000073  2  1328
000073  2  1329        3:  CASE  OUTLINE  OF
000075  3  1330                  1:  WRITE (' CODE *');
000103  3  1331                  2:  WRITE ('COMNT *');
000111  3  1332                  3:  WRITE ('LINES *');
000117  3  1333            END;
000126  2  1334
000126  2  1335        4:  CASE  OUTLINE  OF
000130  3  1336                  1:  WRITE (' NULF *');
000136  3  1337                  2:  WRITE (' STMT *');
000144  3  1338                  3:  WRITE ('LINES *');
000152  3  1339            END;
000161  2  1340
000161  2  1341        5:  CASE  OUTLINE  OF
000163  3  1342                  1:  WRITE (' CONS *');
000171  3  1343                  2:  WRITE ('  AND *');
000177  3  1344                  3:  WRITE ('TYPES *');
000205  3  1345            END;
000214  2  1346
000214  2  1347        6:  CASE  OUTLINE  OF
000216  3  1348                  1:  WRITE ('      *');
000224  3  1349                  2:  WRITE (' DECL *');
000232  3  1350                  3:  WRITE (' VARS *');
000240  3  1351            END;
000247  2  1352
000247  2  1353        7:  CASE  OUTLINE  OF
000251  3  1354                  1:  WRITE (' VARS *');
000257  3  1355                  2:  WRITE ('  NOT *');
000265  3  1356                  3:  WRITE (' USED *');
000273  3  1357            END;
000302  2  1358
000302  2  1359        8:  CASE  OUTLINE  OF
000304  3  1360                  1:  WRITE ('PROCS *');
000312  3  1361                  2:  WRITE ('  AND *');
000320  3  1362                  3:  WRITE ('FUNCS *');
000326  3  1363            END;
000335  2  1364
000335  2  1365        9:  CASE  OUTLINE  OF
000337  3  1366                  1:  WRITE ('      *');
000345  3  1367                  2:  WRITE ('  VAR *');
000353  3  1368                  3:  WRITE ('PARAM *');
```

```
000361  3  1369            END;
000370  2  1370
000370  2  1371        10: CASE  OUTLINE  OF
000372  3  1372                  1:  WRITE (*       *);
000400  3  1373                  2:  WRITE (*  VAL  *);
000406  3  1374                  3:  WRITE (*PARAM  *);
000414  3  1375             END;
000423  2  1376
000423  2  1377        11: CASE  OUTLINE  OF
000425  3  1378                  1:  WRITE (*       *);
000433  3  1379                  2:  WRITE (*  PROC *);
000441  3  1380                  3:  WRITE (*  VARS *);
000447  3  1381            END;
000456  2  1382
000456  2  1383        12: CASE  OUTLINE  OF
000460  3  1384                  1:  WRITE (*       *);
000466  3  1385                  2:  WRITE (*  FOR  *);
000474  3  1386                  3:  WRITE (*STMTS  *);
000502  3  1387            END;
000511  2  1388
000511  2  1389        13: CASE  OUTLINE  OF
000513  3  1390                  1:  WRITE (*       *);
000521  3  1391                  2:  WRITE (*  REP  *);
000527  3  1392                  3:  WRITE (*STMTS  *);
000535  3  1393            END;
000543  2  1394
000544  2  1395        14: CASE  OUTLINE  OF
000546  3  1396                  1:  WRITE (*       *);
000554  3  1397                  2:  WRITE (*WHILE  *);
000562  3  1398                  3:  WRITE (*STMTS  *);
000570  3  1399            END;
000577  2  1400
000577  2  1401        15: CASE  OUTLINE  OF
000601  3  1402                  1:  WRITE (*       *);
000607  3  1403                  2:  WRITE (*  GOTO *);
000615  3  1404                  3:  WRITE (*STMTS  *);
000623  3  1405            END;
000632  2  1406
000632  2  1407        16: CASE  OUTLINE  OF
000634  3  1408                  1:  WRITE (*       *);
000642  3  1409                  2:  WRITE (*  UNIQ *);
000650  3  1410                  3:  WRITE (*OPERS  *);
000658  3  1411            END;
000665  2  1412
000665  2  1413        17: CASE  OUTLINE  OF
000667  3  1414                  1:  WRITE (*       *);
000675  3  1415                  2:  WRITE (*  UNIQ *);
000703  3  1416                  3:  WRITE (*OPNDS  *);
000711  3  1417            END;
000720  2  1418
000720  2  1419        18: CASE  OUTLINE  OF
000722  3  1420                  1:  WRITE (*       *);
000730  3  1421                  2:  WRITE (*TOTAL  *);
000736  3  1422                  3:  WRITE (*OPERS  *);
000744  3  1423            END;
000753  2  1424
000753  2  1425        19: CASE  OUTLINE  OF
```

```
000755  3  1426                  1:  WRITE ('      ');
000763  3  1427                  2:  WRITE ('TOTAL ');
000771  3  1428                  3:  WRITE ('OPNDS ');
000777  3  1429              END;
001006  2  1430
001006  2  1431        20:   CASE  OUTLINE  OF
001010  3  1432                  1:  WRITE ('           ');
001016  3  1433                  2:  WRITE (' INDENTING ');
001024  3  1434                  3:  WRITE ('  FUNCTION ');
001032  3  1435              END;
001041  2  1436
001041  2  1437  END;  (* PARAMETER *)
001057  1  1438
001057  1  1439  END;  (* HEADINGS *)
001125  0  1440
001125  0  1441
001125  0  1442
001125  0  1443  PROCEDURE OUTPUTPROGNOSIS;
000002  0  1444     (* WRITE OUT PROGNOSIS.  KEY AND PARACOUNT ARE CONSIDERED
000002  0  1445        SYNONOMOUS AS IT IS DESIREABLE TO HAVE THE KEY THE FAR
000002  0  1446        RIGHT-HAND PARAMETER *)
000002  0  1447
000002  0  1448  VAR   I, J, PARAMETER,
000002  0  1449        MODINDX:              INTEGER;
000006  0  1450        STOPOUT, SAMEPAGE: BOOLEAN;
000010  0  1451
000010  0  1452  BEGIN (* OUTPUTPROGNOSIS *)
000010  1  1453
000010  1  1454  STOPOUT := FALSE;
000006  1  1455  MODINDX := 0;
000007  1  1456
000007  1  1457  REPEAT
000007  2  1458  WRITELN ('1');
000015  2  1459  FOR OUTLINE := 1 TO 3 DO
000017  2  1460      BEGIN
000021  3  1461      WRITE ('      ');
000034  3  1462      FOR PARAMETER := 1 TO PAPACOUNT DO
000030  3  1463          HEADINGS (PARAMETER);
000041  3  1464      WRITELN;
000042  3  1465      END;
000047  2  1466  WRITELN;
000050  2  1467  SAMEPAGE := TRUE;
000052  2  1468  WHILE  SAMEPAGE AND (MODINDX < MODULE)  DO
000056  2  1469         BEGIN
000056  3  1470         MODINDX := MODINDX + 1;
000057  3  1471         I := ORDER[MODINDX];
000063  3  1472         WRITE (' ',CCID[I]);
000101  3  1473         FOR J := 1 TO (PARACOUNT-1) DO
000104  3  1474         WRITE (PROGNOSIS[I,J]:5,' ');
000130  3  1475         (* PARACOUNT CONTAINS THE INDENTING FUNCTION *)
000130  3  1476         WRITE (PROGNOSIS[I,PARACOUNT]:10);
000137  3  1477         WRITE (' ');
000144  3  1478      (* IF  PRODECLNOTUSED *)
000144  3  1479         IF  PRODECLNOTUSED[I]
000147  3  1480         THEN  WRITE('**');
000155  3  1481      (* IF  VARNOTUSED > 0 *)
000155  3  1482         IF  PROGNOSIS[I,7] > 0
```

```
000161  3  1483          THEN  WRITE ('*');
000167  3  1484          WRITELN;
000171  3  1485          IF  ((MODINDX MOD CCIOPERPAGE) = 0)
000200  3  1486          THEN  SAMEPAGE := FALSE;
000202  3  1487          END;
000203  2  1488          IF  MODINDX < MODULE
000203  2  1489          THEN  SAMEPAGE := TRUE
000205  2  1490          ELSE  STOPOUT := TRUE;
000207  2  1491    UNTIL  STOPOUT;
000211  1  1492
000211  1  1493    WRITELN ('--   VARIABLE(S) WERE DECLARED BUT NOT USED');
000217  1  1494    WRITELN ('  **  PROCEDURE(S) WERE DECLARED BUT NOT USED');
000225  1  1495    WRITELN ('  *** VARIABLE(S) AND PROCEDURE(S) WERE DECLARED BUT NOT USED');
000233  1  1496
000233  1  1497    END;  (* OUTPUTFROMJOSIS *)
000273  0  1498
000273  0  1499
000273  0  1500
000273  0  1501    FUNCTION ADD (KEY1,KEY2:INTEGER): INTEGER;
000005  0  1502       (* ADD RETURNS AS A VALUE KEY1 WHERE
000005  0  1503          PROGNOSIS[KEY1] = PROGNOSIS[KEY1] + PROGNOSIS[KEY2] FOR ALL MODULES *)
000005  0  1504
000005  0  1505    VAR   I:   INTEGER;
000006  0  1506
000006  0  1507    BEGIN (* ADD *)
000006  0  1508
000006  1  1509    FOR I := 1 TO MODULE DO
000011  1  1510       PROGNOSIS[I,KEY1] := PROGNOSIS[I,KEY1] + PROGNOSIS[I,KEY2];
000041  1  1511    ADD := KEY1;
000043  1  1512    ADDWASDONE := TRUE;
000044  1  1513
000044  1  1514    END;  (* ADD *)
000055  0  1515
000055  0  1516
000055  0  1517
000055  0  1518    PROCEDURE STATISTICS (KEY:INTEGER);
000003  0  1519       (* DETERMINE A MATRIX OF WEIGHTS TO DETERMINE THOSE PROGRAMS THAT
000003  0  1520          APPEAR TO BE SIMILAR *)
000003  0  1521
000003  0  1522    VAR   IMPORTANCE,           (* WEIGHT GIVEN TO A PARTICULAR PARAMETER *)
000003  0  1523          DELTA,                (* DIFFERENCE BETWEEN VALUES IN THE WINDOW *)
000003  0  1524          BOTTOM,               (* INDEX THAT RUNS FROM BOTTOMOFWINDOW TO TOP *)
000003  0  1525          TOP,                  (* CURRENT TOP OF WINDOW *)
000003  0  1526          WINDOW,               (* CURRENT SIZE OF WINDOW *)
000003  0  1527          BOTTOMOFWINDOW,       (* CURRENT BOTTOM OF WINDOW *)
000003  0  1528          MINI,                 (* LEFT INDEX FOR STAT *)
000003  0  1529          MAXI:                 (* RIGHT INDEX FOR STAT *)
000003  0  1530                INTEGER;
000013  0  1531
000013  0  1532        PROCEDURE GETNEWTOP;
000002  0  1533           (* GET A NEW TOP OF THE WINDOW *)
000002  0  1534
000002  0  1535        BEGIN (* GETNEWTOP *)
000002  1  1536
000002  1  1537        WHILE ((PROGNOSIS[ORDER[TOP],KEY] - PROGNOSIS[ORDER[BOTTOMOFWINDOW],KEY]) <= WINDOW) AND (TOP <= MODULE)
000031  1  1538              TOP := TOP + 1;
000033  1  1539
```

```
000033  1  1540            END;  (* GETNEWTOP *)
000035  0  1541
000035  0  1542            PROCEDURE MIN (X,Y:INTEGER);
000004  0  1543
000004  0  1544            BEGIN (* MIN *)
000004  1  1545
000004  1  1546            IF  X < Y
000004  1  1547            THEN  BEGIN
000006  2  1548                  MINI := X;
000007  2  1549                  MAXI := Y;
000010  2  1550                  END
000010  1  1551            ELSE  BEGIN
000011  2  1552                  MINI := Y;
000013  2  1553                  MAXI := X;
000014  2  1554                  END;
000014  1  1555
000014  1  1556            END;  (* MIN *)
000022  0  1557
000022  0  1558  BEGIN (* STATISTICS *)
000022  1  1559
000022  1  1560  CASE  KEY  OF
000005  2  1561
000005  2  1562        2:  BEGIN
000005  3  1563            WINDOW := 3;
000007  3  1564            IMPORTANCE := 5;
000010  3  1565            END;
000011  2  1566
000011  2  1567        8:  BEGIN
000011  3  1568            WINDOW := 2;
000013  3  1569            IMPORTANCE := 3;
000014  3  1570            END;
000015  2  1571
000015  2  1572        12: BEGIN
000015  3  1573            WINDOW := 1;
000017  3  1574            IMPORTANCE := 2;
000020  3  1575            END;
000021  2  1576
000021  2  1577        16: BEGIN
000021  3  1578            WINDOW := 3;
000023  3  1579            IMPORTANCE := 5;
000024  3  1580            END;
000025  2  1581
000025  2  1582        17: BEGIN
000025  3  1583            WINDOW := 3;
000027  3  1584            IMPORTANCE := 5;
000030  3  1585            END;
000031  2  1586
000031  2  1587        18: BEGIN
000031  3  1588            WINDOW := 5;
000033  3  1589            IMPORTANCE := 6;
000034  3  1590            END;
000035  2  1591
000035  2  1592        19: BEGIN
000035  3  1593            WINDOW := 5;
000037  3  1594            IMPORTANCE := 6;
000040  3  1595            END;
000041  2  1596
```

```
000041  2  1597        OTHERWISE  BEGIN
000058  3  1598                   WINDOW := 1;
000060  3  1599                   IMPORTANCE := 1;
000061  3  1600                   END;
000061  2  1601
000061  2  1602        END;  (* CASE *)
000061  1  1603
000061  1  1604
000061  1  1605  BOTTOMOFWINDOW := 1;
000063  1  1606  TOP := 2;
000064  1  1607  GETNEWTOP:
000066  1  1608
000066  1  1609  WHILE  BOTTOMOFWINDOW < MODULE  DO
000071  1  1610         BEGIN
000071  2  1611         BOTTOM := BOTTOMOFWINDOW + 1;
000072  2  1612         WHILE  BOTTOM <= (TOP-1)  DO
000075  2  1613                BEGIN
000075  3  1614                DELTA := PROGNOSIS[ORDER[BOTTOM].KEY] - PROGNOSIS[ORDER[BOTTOMOFWINDOW].KEY];
000117  3  1615                MIN (ORDER[BOTTOMOFWINDOW].ORDER[BOTTOM]);
000125  3  1616                STAT[MIN].MAXI] := STAT[MIN].MAXI] + (IMPORTANCE-DELTA);
000140  3  1617                BOTTOM := BOTTOM + 1;
000141  3  1618                END;
000142  2  1619         BOTTOMOFWINDOW := BOTTOMOFWINDOW + 1;
000144  2  1620         IF  PROGNOSIS[ORDER[BOTTOMOFWINDOW].KEY] > PROGNOSIS[ORDER[BOTTOMOFWINDOW-1].KEY]
000163  2  1621         THEN  GETNEWTOP;
000167  2  1622         END;
000170  1  1623
000170  1  1624  END;  (* STATISTICS *)
000214  0  1625
000214  0  1626
000214  0  1627
000214  0  1628
000214  0  1629  PROCEDURE MORESORTS (KEY1,KEY2,KEY3,KEY4,KEY5,KEY6,KEY7: INTEGER);
000011  0  1630      (* MAKE ADDITIONAL SORTS AS REQUESTED.
000011  0  1631         OUTPUT:
000011  0  1632            LIST OF CCIDS AND SORTED LIST OF DESIGNATED KEYS *)
000011  0  1633
000011  0  1634  VAR
000011  0  1635         I,J,SORTSREQUESTED:    INTEGER;
000014  0  1636         KEYS:                  ARRAY [1..7] OF INTEGER;
000023  0  1637         RESULTS:               ARRAY [1..7,MODULENUMBERS] OF INTEGER;
001747  0  1638         MODINDX:               INTEGER;
001750  0  1639         STOPOUT,SAMEPAGE:      BOOLEAN;
001752  0  1640
001752  0  1641  BEGIN (* MORESORTS *)
001752  1  1642
001752  1  1643  KEYS[1] := KEY1;
000006  1  1644  KEYS[2] := KEY2;
000007  1  1645  KEYS[3] := KEY3;
000010  1  1646  KEYS[4] := KEY4;
000011  1  1647  KEYS[5] := KEY5;
000012  1  1648  KEYS[6] := KEY6;
000014  1  1649  KEYS[7] := KEY7;
000015  1  1650
000015  1  1651  SORTSREQUESTED := 0;
000016  1  1652
000016  1  1653  FOR I := 1 TO 7 DO
```

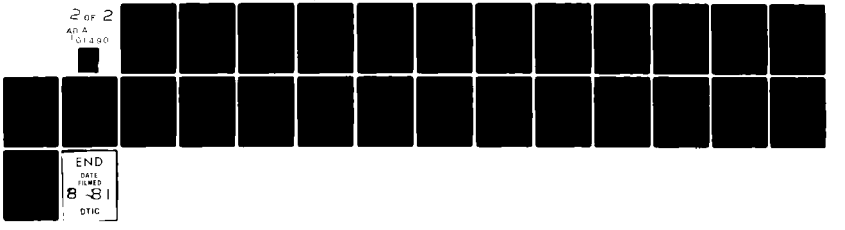
```
000017  1  1654       IF  (KEYS[I] <= PARACOUNT) AND (KEYS[I] > 0)
000030  1  1655       THEN  BEGIN
000031  2  1656             SORTSREQUESTED := SORTSREQUESTED + 1;
000032  2  1657             KEY := KEYS[I];
000036  2  1658             KEYS[SORTSREQUESTED] := KEY;
000041  2  1659             SORTPROGNOSIS (I,MODULE);
000043  2  1660             STATISTICS (KEY);
000045  2  1661
000045  2  1662             FOR J := 1 TO MODULE DO
000050  2  1663               RESULTS[SORTSREQUESTED,J] := ORDER[J];
000065  2  1664             END;
000072  1  1665
000072  1  1666  STOPOUT := FALSE;
000073  1  1667  MODINDX := 0;
000075  1  1668
000075  1  1669  IF  SORTSREQUESTED > 0
000075  1  1670  THEN  REPEAT
000077  2  1671        WRITELN ('1');
000105  2  1672        FOR OUTLINE := 1 TO 3 DO
000107  2  1673            BEGIN
000111  3  1674            FOR I := 1 TO SORTSREQUESTED DO
000114  3  1675                BEGIN
000116  4  1676                WRITE ('             ');
000123  4  1677                HEADINGS (KEYS[I]);
000130  4  1678                END;
000135  3  1679            WRITELN;
000136  3  1680            END;
000143  2  1681        WRITELN;
000144  2  1682        SAMEPAGE := TRUE;
000146  2  1683        WHILE  SAMEPAGE AND (MODINDX < MODULE)  DO
000151  2  1684               BEGIN
000151  3  1685               MODINDX := MODINDX + 1;
000153  3  1686               FOR I := 1 TO SORTSREQUESTED DO
000155  3  1687                   BEGIN
000157  4  1688                   WRITE ('       ',CCID[RESULTS[I,MODINDX]],' ');
000207  4  1689                   WRITE (PROGNOSIS[RESULTS[I,MODINDX],KEYS[I]]:5,' ');
000235  4  1690                   END;
000242  3  1691               WRITELN;
000243  3  1692               IF  ((MODINDX MOD CCIOPERPAGE) = 0)
000252  3  1693               THEN  SAMEPAGE := FALSE;
000254  3  1694               END;
000255  2  1695        IF  MODINDX < MODULE
000255  2  1696        THEN  SAMEPAGE := TRUE
000257  2  1697        ELSE  STOPOUT := TRUE;
000261  2  1698        UNTIL  STOPOUT;
000263  1  1699
000263  1  1700   IF  ADDWASDONE
000263  1  1701   THEN  WRITELN ('-WARNING: HEADING(S) ARE NOT CORRECT.  AT LEAST',
000272  1  1702                  ' ONE REFLECTS A SUM OF TWO COUNTS.');
000300  1  1703
000300  1  1704  END;  (* MORESORTS *)
000359  0  1705
000350  0  1706
000350  0  1707
000350  0  1708  PROCEDURE PRINTFREQ;
000002  0  1709     (* COMPILE AND PRINT THE FREQUENCY DISTRIBUTION GRAPH FOR STAT *)
000002  0  1710
```

```
000002  0  1711  CONST   MINWEIGHT = 0;
000002  0  1712          MAXWEIGHT = 32;
000002  0  1713          MAXEXPECTED = 25;
000002  0  1714          LOWESTCHECK = 28;
000002  0  1715
000002  0  1716  VAR     STILLHITS,          (* NUMBER OF 0 HIT PAIRS *)
000002  0  1717          WEIGHT,             (* WEIGHT OF A PARTICULAR PAIR *)
000002  0  1718          NHIT28,             (* NUMBER OF 28 HITS *)
000002  0  1719          NHIT29,             (* NUMBER OF 29 HITS *)
000002  0  1720          NHIT30,             (* NUMBER OF 30 HITS *)
000002  0  1721          NHIT31,             (* NUMBER OF 31 HITS *)
000002  0  1722          NHIT32,             (* NUMBER OF 32 HITS *)
000002  0  1723          HINGE1,             (* FIRST HINGE FROM 5-NUMBER SUMMARY *)
000002  0  1724          HINGE2,             (* SECOND HINGE FROM 5-NUMBER SUMMARY *)
000002  0  1725          HINGEVAL1,          (* VALUE OF CORRELATION NUMBER AT HINGE1 *)
000002  0  1726          HINGEVAL2,          (* VALUE OF CORRELATION NUMBER AT HINGE2 *)
000002  0  1727          STEP,               (* DIFFERENCE IN VALUE OF TWO HINGES *)
000002  0  1728          OUTERFENCE,         (* CORRELATIONS BEYOND THE OUTERFENCE ARE SUSPECTED OF PLAGIARISM *)
000002  0  1729          PAIRS,              (* (MODULE * (MODULE-1)) DIV 2 *)
000002  0  1730          MEDIAN,             (* MEDIAN OF PAIRS *)
000002  0  1731          I,J:                (* UTILITY INDEX *)
000002  0  1732                      INTEGER;
000023  0  1733          LOOKING1,           (* TRUE IF HINGEVAL1 NOT FOUND *)
000023  0  1734          LOOKING2:           (* TRUE IF HINGEVAL2 NOT FOUND *)
000023  0  1735                      BOOLEAN;
000025  0  1736          HITS:               (* HOLDS WEIGHT OCCURENCES FROM STAT *)
000025  0  1737                    ARRAY [MINWEIGHT..MAXWEIGHT] OF INTEGER;
000065  0  1738          CHECK:              (* CONTAINS PAIRS OF PROGRAMS THAT HAVE LIKE HITS *)
000065  0  1739                    ARRAY [LOWESTCHECK..MAXWEIGHT,1..MAXEXPECTED,1..2] OF INTEGER;
000460  0  1740
000460  0  1741            PROCEDURE PRINTGRAPH;
000002  0  1742               (* PRINT THE TABLE FOR THE FREQUENCY DISTRIBUTION *)
000002  0  1743
000002  0  1744            VAR   I:   INTEGER;
000003  0  1745
000003  0  1746            BEGIN (* PRINTGRAPH *)
000003  1  1747
000003  1  1748            WRITELN ('-');
000012  1  1749            WRITELN (' FREQUENCY DISTRIBUTION GRAPH FOR PAIRS OF PROGRAMS');
000020  1  1750            WRITELN ('-');
000026  1  1751            WRITE (' ':20);
000032  1  1752            FOR I := MINWEIGHT TO MAXWEIGHT DO
000034  1  1753                WRITE (I:3);
000046  1  1754            WRITELN;
000047  1  1755            WRITE (' ':20);
000053  1  1756            FOR I := MINWEIGHT TO MAXWEIGHT DO
000055  1  1757                WRITE ('---');
000070  1  1758            WRITELN;
000071  1  1759
000071  1  1760            END;  (* PRINTGRAPH *)
000104  0  1761
000104  0  1762  BEGIN (* PRINTFREQ *)
000104  1  1763
000104  1  1764  FOR I := MINWEIGHT TO MAXWEIGHT DO
000006  1  1765      HITS[I] := 0;
000016  1  1766  NHIT28 := 0;  NHIT29 := 0;  NHIT30 := 0;  NHIT31 := 0;  NHIT32 := 0;
000021  1  1767  FOR I := 1 TO (MODULE-1) DO
```

```
000024  1  1788        FOR J := (I+1) TO MODULE DO
000031  1  1789            BEGIN
000033  2  1790            WEIGHT := STAT[I,J];
000042  2  1791            HITS[WEIGHT] := HITS[WEIGHT] + 1;
000047  2  1792            CASE  WEIGHT  OF
000050  3  1793                  28:  BEGIN
000050  4  1794                       NHIT28 := NHIT28 + 1;
000052  4  1795                       CHECK[WEIGHT,NHIT28,1] := I;
000062  4  1796                       CHECK[WEIGHT,NHIT28,2] := J;
000071  4  1797                       END;
000072  3  1798                  29:  BEGIN
000072  4  1799                       NHIT29 := NHIT29 + 1;
000074  4  1800                       CHECK[WEIGHT,NHIT29,1] := I;
000104  4  1801                       CHECK[WEIGHT,NHIT29,2] := J;
000113  4  1802                       END;
000114  3  1803                  30:  BEGIN
000114  4  1804                       NHIT30 := NHIT30 + 1;
000116  4  1805                       CHECK[WEIGHT,NHIT30,1] := I;
000126  4  1806                       CHECK[WEIGHT,NHIT30,2] := J;
000135  4  1807                       END;
000136  3  1808                  31:  BEGIN
000136  4  1809                       NHIT31 := NHIT31 + 1;
000140  4  1810                       CHECK[WEIGHT,NHIT31,1] := I;
000150  4  1811                       CHECK[WEIGHT,NHIT31,2] := J;
000157  4  1812                       END;
000160  3  1813                  32:  BEGIN
000160  4  1814                       NHIT32 := NHIT32 + 1;
000162  4  1815                       CHECK[WEIGHT,NHIT32,1] := I;
000172  4  1816                       CHECK[WEIGHT,NHIT32,2] := J;
000201  4  1817                       END;
000202  3  1818                  OTHERWISE:
000211  3  1819                  END;  (* CASE *)
000211  2  1820            END;
000222  1  1821
000222  1  1822  PAIRS := (MODULE * (MODULE-1)) DIV 2;
000225  1  1823  MEDIAN := (PAIRS + 1) DIV 2;
000227  1  1824  HINGE1 := (1 + MEDIAN) DIV 2;
000231  1  1825  HINGE2 := (MEDIAN - 1) + HINGE1;
000233  1  1826  LOOKING1 := TRUE;
000234  1  1827  LOOKING2 := TRUE;
000235  1  1828  WEIGHT := 0;
000236  1  1829  I      := 0;
000237  1  1830
000237  1  1831  WHILE  (LOOKING1 OR LOOKING2)  DO
000241  1  1832         BEGIN
000241  2  1833         WEIGHT := HITS[I] + WEIGHT;
000246  2  1834         IF  LOOKING1
000246  2  1835         THEN  IF  WEIGHT >= HINGE1
000247  2  1836               THEN  BEGIN
000251  3  1837                     HINGEVAL1 := I;
000252  3  1838                     LOOKING1 := FALSE;
000253  3  1839                     END;
000253  2  1840         IF  LOOKING2
000253  2  1841         THEN  IF  WEIGHT >= HINGE2
000255  2  1842               THEN  BEGIN
000257  3  1843                     HINGEVAL2 := I;
000261  3  1844                     LOOKING2 := FALSE;
```

```
000262  3  1825                    END;
000262  2  1826          I := I + 1;
000264  2  1827          END;
000265  1  1828  STEP := HINGEVAL2 - HINGEVAL1;
000267  1  1829  OUTERFENCE := (3 * STEP) + HINGEVAL2;
000271  1  1830
000271  1  1831  WRITELN ('1'):  WRITELN ('-');
000304  1  1832  WRITELN (' TUKEY ESTIMATE FOR SUSPICION OF PLAGIARISM: ', (OUTERFENCE+1):3);
000316  1  1833
000316  1  1834  FOR I := MINWEIGHT TO MAXWEIGHT DO
000320  1  1835      IF  HITS[I] > 40
000324  1  1836      THEN  HITS[I] := 40;
000335  1  1837  PRINTGRAPH;
000336  1  1838  STILLHITS := 0;
000340  1  1839  WHILE  STILLHITS < MAXWEIGHT  DO
000343  1  1840         BEGIN
000343  2  1841         STILLHITS := 0;
000344  2  1842         WRITE (' ':20);
000350  2  1843         FOR I := MINWEIGHT TO MAXWEIGHT DO
000352  2  1844             BEGIN
000354  3  1845             IF  HITS[I] = 0
000356  3  1846             THEN  BEGIN
000360  4  1847                   STILLHITS := STILLHITS + 1;
000362  4  1848                   WRITE ('   ');
000367  4  1849                   END
000367  3  1850             ELSE  BEGIN
000370  4  1851                   HITS[I] := HITS[I] - 1;
000375  4  1852                   WRITE ('  *');
000402  4  1853                   END;
000402  3  1854             END;
000407  2  1855         WRITELN;
000410  2  1856         END;
000411  1  1857  WRITELN ('1');
000417  1  1858  FOR I := LOWESTCHECK TO MAXWEIGHT DO
000421  1  1859      CASE  I  OF
000424  2  1860           28:  IF  NHIT28 > 0  THEN
000426  2  1861                BEGIN
000426  3  1862                WRITELN (' THE FOLLOWING PAIRS HAVE A CORRELATION OF 28:');
000434  3  1863                FOR J := 1 TO NHIT28 DO
000437  3  1864                    WRITELN (' ':10,CCID[CHECK[I,J,1]],'.',CCID[CHECK[I,J,2]]);
000521  3  1865                END;
000522  2  1866           29:  IF  NHIT29 > 0  THEN
000524  2  1867                BEGIN
000524  3  1868                WRITELN (' THE FOLLOWING PAIRS HAVE A CORRELATION OF 29:');
000532  3  1869                FOR J := 1 TO NHIT29 DO
000535  3  1870                    WRITELN (' ':10,CCID[CHECK[I,J,1]],'.',CCID[CHECK[I,J,2]]);
000617  3  1871                END;
000620  2  1872           30:  IF  NHIT30 > 0  THEN
000622  2  1873                BEGIN
000622  3  1874                WRITELN (' THE FOLLOWING PAIRS HAVE A CORRELATION OF 30:');
000630  3  1875                FOR J := 1 TO NHIT30 DO
000633  3  1876                    WRITELN (' ':10,CCID[CHECK[I,J,1]],'.',CCID[CHECK[I,J,2]]);
000715  3  1877                END;
000716  2  1878           31:  IF  NHIT31 > 0  THEN
000720  2  1879                BEGIN
000720  3  1880                WRITELN (' THE FOLLOWING PAIRS HAVE A CORRELATION OF 31:');
000726  3  1881                FOR J := 1 TO NHIT31 DO
```

AD-A101 490 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH F/G 9/2
A TOOL FOR DETECTING PLAGIARISM IN PASCAL PROGRAMS.(U)
DEC 80 S L GRIER
UNCLASSIFIED AFIT-CI-80-74T NL



```
000731  3  1882                    WRITELN (* *:10,CCID[CHECK[I,J,1]],*,*,CCID[CHECK[I,J,2]]);
001013  3  1883                END;
001014  2  1884           32:  IF  NHIT32 > 0  THEN
001016  2  1885                BEGIN
001016  3  1886                WRITELN (*- THE FOLLOWING PAIRS HAVE A CORRELATION OF 32:*);
001024  3  1887                FOR J := 1 TO NHIT32 DO
001027  3  1888                    WRITELN (* *:10,CCID[CHECK[I,J,1]],*,*,CCID[CHECK[I,J,2]]);
001111  3  1889                END;
001112  2  1890           END;
001126  1  1891
001126  1  1892  END;  (* PRINTFREQ *)
001236  0  1893
001236  0  1894
001236  0  1895
001236  0  1896  PROCEDURE COUNT;
000003  0  1897     (* ADDS UP THE OCCURRENCES OF THE VARIOUS PARAMETERS *)
000003  0  1898
000003  0  1899  BEGIN (* COUNT *)
000003  1  1900
000003  1  1901  CASE COUNTER OF
000005  2  1902
000005  2  1903  EPLIN:     TOTALLINES := TOTALLINES + 1;
000010  2  1904
000010  2  1905  EPOPS:     OPERATORS := OPERATORS + 1;
000013  2  1906           (* OPERATORS CAN BE DECREMENTED IN LBRAC IN DRIVER
000013  2  1907              ASSIGNMENT OPERATORS ARE NOT COUNTED *)
000013  2  1908
000013  2  1909  EPCT:      CONSANDTYPES := CONSANDTYPES + 1;
000016  2  1910
000016  2  1911  UNOPN:     UNIQUEOPN := UNIQUEOPN + 1;
000021  2  1912           (* VARNOTUSED WILL BE SUBTRACTED FROM UNIQUEOPN - SEE MODFINI *)
000021  2  1913
000021  2  1914  EPVAR:     VARIABLES := VARIABLES + 1;
000024  2  1915           (* VARNOTUSED WILL BE SUBTRACTED FROM VARIABLES - SEE MODFINI *)
000024  2  1916
000024  2  1917  VARPA:     VARPARA := VARPARA + 1;
000027  2  1918
000027  2  1919  PRVAR:     PROVAR := PROVAR + 1;
000032  2  1920           (* PROVAR CAN BE DECREMENTED IN EXITPROCEDURE *)
000032  2  1921
000032  2  1922  EPPRO:     PROCANDFUNC := PROCANDFUNC + 1;
000035  2  1923
000035  2  1924  EPOPN:     OPERANDS := OPERANDS + 1;
000040  2  1925           (* DECREMENTED IN ASSIGN IN DRIVER *)
000040  2  1926
000040  2  1927  FORCT:     FORSTMT := FORSTMT + 1;
000043  2  1928
000043  2  1929  GOCNT:     GO := GO + 1;
000046  2  1930
000046  2  1931  REPCT:     REPSTMT := REPSTMT + 1;
000051  2  1932
000051  2  1933  WHICT:     WHISTMT := WHISTMT + 1;
000054  2  1934
000054  2  1935  EPCOM:     TOTALCOMMENTS := TOTALCOMMENTS + LINESOFCOMMENT;
000057  2  1936
000057  2  1937  EPMOL:     MORETHANONE := MORETHANONE + 1;
000062  2  1938
```

```
000062  2  1939  VALPA:      VALPARA := VALPARA + 1;
000065  2  1940
000065  2  1941  EPCL:       CODELINES := CODELINES + 1;
000070  2  1942             (* DECREMENTED BY ASSIGN IN DRIVER
000070  2  1943                INCREMENTED BY MORETHANONE - SEE MODFINI *)
000070  2  1944
000070  2  1945  INDNF:     (* INDENTING FUNCTION *)
000070  2  1946               IF  (LINE[INDEX]<>"(") AND (LINE[INDEX+1]<>"*")
000100  2  1947               THEN  BEGIN
000102  3  1948                     COUNT (EPCL);
000105  3  1949                     IF  ABS (STARTPOS - NUMBLNKS) > SIGINDENT
000110  3  1950                     THEN  BEGIN
000111  4  1951                           IF  (STARTPOS - NUMBLNKS) > 0
000112  4  1952                           THEN  RIGHTINDENT := RIGHTINDENT + 1
000113  4  1953                           ELSE  LEFTINDENT  := LEFTINDENT  + 1;
000117  4  1954                           STARTPOS := NUMBLNKS;
000121  4  1955                           END
000121  3  1956                     ELSE  ZEROINDENT := ZEROINDENT + 1;
000124  3  1957                     END;
000125  2  1958
000125  2  1959  UNOPS:      COUNTUNOPS;
000127  2  1960
000127  2  1961  VARNU:      VARNOTUSED := VARNOTUSED + 1;
000132  2  1962
000132  2  1963  END;  (* CASE *)
000147  1  1964
000147  1  1965  END;  (* COUNT *)
000153  0  1966
000153  0  1967
000153  0  1968
000153  0  1969  PROCEDURE DRIVER;
000002  0  1970     (* THIS IS THE DRIVER THAT MAKES THE COUNTS AND CALLS THE SCANNER.
000002  0  1971        IT UTILIZES THE FACT THAT THE PROGRAM IS COMPILEABLE. *)
000002  0  1972
000002  0  1973  LABEL   3,4;
000002  0  1974
000002  0  1975  VAR   LPARCOUNT,
000002  0  1976        I,TEMPEND:      INTEGER;
000005  0  1977        BUFF:           CMBUFF;
000017  0  1978        PTR,
000017  0  1979        AUXPTR:         SYMLINK;
000021  0  1980        RESKEY,
000021  0  1981        STILLLBL,
000021  0  1982        STILLTYPEORCON,
000021  0  1983        STILLVAR,
000021  0  1984        STILLVAL:       BOOLEAN;
000026  0  1985
000026  0  1986             PROCEDURE PROCESSRECORD;
000002  0  1987             FORWARD;
000002  0  1988
000002  0  1989             PROCEDURE PROCESSCASE;
000002  0  1990             FORWARD;
000002  0  1991
000002  0  1992             PROCEDURE PROCESSENUMTYPE;
000002  0  1993                (* PROCESS AN ENUMERATED TYPE DECLARATION WITHIN A TYPE DECL OR CASE
000002  0  1994                   STMT.  ANY RESERVED WORDS FOUND ARE REMOVED FROM THE SYMBOL TABLE *)
000002  0  1995
```

```
000002  0  1996            VAR   STILLENUMTYPE:  BOOLEAN;
000003  0  1997
000003  0  1998            BEGIN (* PROCESSENUMTYPE *)
000003  1  1999
000003  1  2000            STILLENUMTYPE := TRUE;
000006  1  2001            WHILE  STILLENUMTYPE  DO
000010  1  2002                   BEGIN
000010  2  2003                   SCANNER;
000011  2  2004                   CASE  ACTION  OF
000013  3  2005                         ABT:       ABORT;
000015  3  2006                         BLNKS:     NEWLINE := FALSE;
000017  3  2007                         COMNT,
000017  3  2008                         COMMA,
000017  3  2009                         SEMI:;
000020  3  2010                         RPAR:      STILLENUMTYPE := FALSE;
000022  3  2011                         COLON:     BEGIN (* GO TO END OF CURRENT ITEM *)
000022  4  2012                                    WHILE  (ACTION <> SEMI) AND (ACTION <> RPAR)  DO
000027  4  2013                                           BEGIN
000027  5  2014                                           SCANNER;
000030  5  2015                                           CASE  ACTION  OF
000032  6  2016                                                 BLNKS:     NEWLINE := FALSE;
000034  6  2017                                                 RPAR:      STILLENUMTYPE := FALSE;
000036  6  2018                                                 OTHERWISE;
000050  6  2019                                                 END;
000050  5  2020                                           END;
000051  4  2021                                    END;
000052  3  2022                         OTHERWISE  BEGIN
000075  4  2023                                    IF  KEYWORD
000075  4  2024                                    THEN  IF  ISADELIMITER
000077  4  2025                                          THEN  ABORT
000100  4  2026                                          ELSE  REDEF;
000103  4  2027                                    COUNT (UNDFN);
000106  4  2028                                    COUNT (EPVAR);
000111  4  2029                                    DECLARE;
000112  4  2030                                    END;
000112  3  2031                         END;
000112  2  2032
000112  2  2033                   END;
000113  1  2034            END;  (* PROCESSENUMTYPE *)
000117  0  2035
000117  0  2036            PROCEDURE PROCESSRECORD;
000002  0  2037               (* PROCESS A RECORD WITHIN A DECL *)
000002  0  2038
000002  0  2039            VAR   LHS,
000002  0  2040                  STILLRECORD:   BOOLEAN;
000004  0  2041
000004  0  2042            BEGIN (* PROCESSRECORD *)
000004  1  2043
000004  1  2044            LHS := TRUE;
000006  1  2045            STILLRECORD := TRUE;
000007  1  2046            WHILE  STILLRECORD  DO
000011  1  2047                   BEGIN
000011  2  2048                   IF  YES
000011  2  2049                   THEN  SCANNER;
000013  2  2050                   CASE  ACTION  OF
000015  3  2051                         ABT:           ABORT;
000017  3  2052                         BLNKS:         NEWLINE := FALSE;
```

```
000021  3  2053                        COMMA,
000021  3  2054                        COMMT::
000022  3  2055                        SEMI:           LHS := TRUE:
000024  3  2056                        COLON:          LHS := FALSE:
000026  3  2057                        LPAR:           PROCESSENUMTYPE:
000031  3  2058                        RECDEC:         PROCESSRECORD:
000034  3  2059                        CASEST:         PROCESSCASE:
000037  3  2060                        FINDEND:        STILLRECORD := FALSE;
000041  3  2061                        OTHERWISE       IF  LHS
000066  3  2062                                        THEN  BEGIN
000070  4  2063                                              IF  KEYWORD
000070  4  2064                                              THEN  IF  ISADELIMITER
000071  4  2065                                                    THEN  ABORT
000073  4  2066                                                    ELSE  REDEF;
000076  4  2067                                              COUNT (UNDFN);
000101  4  2068                                              COUNT (EPVAR);
000104  4  2069                                              DECLARE;
000105  4  2070                                              END;
000105  3  2071                        END;
000105  2  2072                  END;
000106  1  2073
000106  1  2074            END;  (* PROCESSRECORD *)
000114  0  2075
000114  0  2076            PROCEDURE PROCESSCASE;
000002  0  2077               (* PROCESS A CASE STMT WITHIN A DECL *)
000002  0  2078
000002  0  2079            VAR   STILLCASE:   BOOLEAN;
000003  0  2080
000003  0  2081                  PROCEDURE TAKEITOUT;
000002  0  2082                     (* STORE THE CONTENTS OF IDENBUFF *)
000002  0  2083
000002  0  2084                  VAR   I:   INTEGER;
000003  0  2085
000003  0  2086                  BEGIN (* TAKEITOUT *)
000003  1  2087
000003  1  2088                  FOR I := 1 TO ENDIDEN DO
000007  1  2089                     BUFF[I] := IDENBUFF[I];
000024  1  2090                  TEMPEND := ENDIDEN;
000026  1  2091
000026  1  2092                  END;  (* TAKEITOUT *)
000032  0  2093
000032  0  2094                  PROCEDURE PUTITBACK;
000002  0  2095                     (* REINSERT THE CONTENTS OF IDENBUFF *)
000002  0  2096
000002  0  2097                  VAR   I:   INTEGER;
000003  0  2098
000003  0  2099                  BEGIN (* PUTITBACK *)
000003  1  2100
000003  1  2101                  FOR I := 1 TO TEMPEND DO
000007  1  2102                     IDENBUFF[I] := BUFF[I];
000025  1  2103                  ENDIDEN := TEMPEND;
000031  1  2104
000031  1  2105                  END;  (* PUTITBACK *)
000035  0  2106
000035  0  2107            BEGIN (* PROCESSCASE *)
000035  1  2108
000035  1  2109            SCANNER;
```

```
000005  1  2110            WHILE  ACTION = BLNKS  DO
000010  1  2111                   BEGIN  (* SKIP BLANKS *)
000010  2  2112                   NEWLINE := FALSE;
000011  2  2113                   SCANNER;
000012  2  2114                   END;
000013  1  2115            RESKEY := FALSE;
000015  1  2116            IF  KEYWORD
000015  1  2117            THEN  BEGIN  (* SAVE CURRENT ITEM *)
000016  2  2118                  PTR := PTRSYMTBL;
000020  2  2119                  RESKEY := TRUE;
000021  2  2120                  END;
000021  1  2121            TAKEITOUT;
000023  1  2122            SCANNER;
000024  1  2123            WHILE  ACTION = BLNKS  DO
000027  1  2124                   BEGIN  (* SKIP BLANKS *)
000027  2  2125                   NEWLINE := FALSE;
000030  2  2126                   SCANNER;
000031  2  2127                   END;
000032  1  2128            IF  ACTION = COLON  (* CHECK IF ITEM WAS A TAG *)
000032  1  2129            THEN  BEGIN
000034  2  2130                  PUTITBACK;
000036  2  2131                  COUNT (UNOPN);
000041  2  2132                  COUNT (EPVAR);
000044  2  2133                  IF  RESKEY
000044  2  2134                  THEN  BEGIN  (* REDEFINE KEYWORD *)
000046  3  2135                        PTRSYMTBL := PTR;
000050  3  2136                        REDEF;
000051  3  2137                        END;
000051  2  2138                  DECLARE;
000052  2  2139                  END;
000052  1  2140            WHILE  ACTION <> FINDOF  DO
000055  1  2141                   BEGIN
000055  2  2142                   SCANNER;
000056  2  2143                   CASE  ACTION  OF
000060  3  2144                         ABT:       ABORT;
000062  3  2145                         BLNKS:     NEWLINE := FALSE;
000064  3  2146                         LPAR:      BEGIN
000064  4  2147                                    COUNT (EPCT);
000  7  4  2148                                    PROCESSENUMTYPE;
00   1  4  2149                                    END;
0C   7  3  2150                         OTHERWISE;
00   1  3  2151                         END;
0001 1  2  2152                   END;
000  1  1  2153            STILLCASE := TRUE;
000  1  1  2154            WHILE  STILLCASE  DO
0001 6  1  2155                   BEGIN
000118 2  2156                   IF  YES
0001 6  2  2157                   THEN  SCANNER;
0001   2  2158                   CASE  ACTION  OF
0001   3  2159                         ABT:       ABORT;
0001   3  2160                         BLNKS:     NEWLINE := FALSE;
0001   3  2161                         COMNT,
0001   3  2162                         COMMA,
0001   3  2163                         SEMI,
0001   3  2164                         COLON:;
0001   3  2165                         LPAR:      PROCESSENUMTYPE;
0001   3  2166                         RECDEC:    PROCESSRECORD;
```

```
000135  3  2167                        CASES?:    PROCESSCASE:
000140  3  2168                        FINDEND:   BEGIN
000140  4  2169                                   STILLCASE := FALSE:
000142  4  2170                                   YES := FALSE:
000143  4  2171                                   END;
000144  3  2172                        OTHERWISE:
000171  3  2173                        END:
000171  2  2174                    END;
000172  1  2175
000172  1  2176            END;  (* PROCESSCASE *)
000176  0  2177
000176  0  2178  BEGIN (* DRIVER *)
000176  1  2179
000176  1  2180  WHILE  TRUE  DO
000006  1  2181  BEGIN (* WHILE *)
000006  2  2182
000006  2  2183  IF  YES  (* SCAN IF REQUIRED *)
000006  2  2184  THEN  SCANNER;
000010  2  2185  YES := TRUE;
000012  2  2186  IF  KEYWORD
000012  2  2187  THEN  IF  PTRSYMTBL^.OP
000020  2  2188        THEN  BEGIN  (* COUNT OPERATORS *)
000021  3  2189              PTRSYMTBL^.USED := TRUE;
000025  3  2190              COUNT (EPOPS);
000030  3  2191              END;
000030  2  2192
000030  2  2193  CASE  ACTION  OF  (* PERFORM THE REQUESTED ACTION *)
000032  3  2194
000032  3  2195  LBLDEC:   (* IGNORE ALL OF THE LABEL DECLARATION *)
000032  3  2196            BEGIN
000032  4  2197            STILLLBL := TRUE;
000034  4  2198            WHILE  STILLLBL  DO
000036  4  2199                   BEGIN  (* LOOK FOR THE END OF THE LABEL DECL *)
000036  5  2200                   SCANNER;
000037  5  2201                   CASE  ACTION  OF
000041  6  2202                         PROCS,
000041  6  2203                         LBLDEC.CONDEC,
000041  6  2204                         TYPDEC.VARDEC,
000041  6  2205                         VALDEC.FINDBEG: BEGIN
000041  7  2206                                         STILLLBL := FALSE:
000043  7  2207                                         YES := FALSE:
000044  7  2208                                         END;
000045  6  2209                         BLNKS:          NEWLINE := FALSE:
000047  6  2210                         OTHERWISE:
000067  6  2211                         END;
000067  5  2212                   END;
000070  4  2213            END;
000071  3  2214
000071  3  2215  CONDEC,
000071  3  2216  TYPDEC:   (* COUNT THE NUMBER OF TYPE DECLARATIONS AND CONSTANTS *)
000071  3  2217            BEGIN
000071  4  2218            STILLTYPEORCON := TRUE;
000073  4  2219            WHILE  STILLTYPEORCON  DO
000075  4  2220                   BEGIN  (* LOOK FOR THE END OF THE TYPE OR CONST DECL *)
000075  5  2221                   SCANNER;
000076  5  2222                   CASE  ACTION  OF
000100  6  2223                         PROCS,
```

```
000160  6  2224                        LBLDEC.CONDEC.
000160  6  2225                        TYPDEC.VARDEC.
000160  6  2226                        VALDEC.FINDBEG: BEGIN
000160  7  2227                                        STILLTYPEORCON := FALSE;
000162  7  2228                                        YES := FALSE;
000163  7  2229                                        END;
000164  6  2230                        EQUAL:          COUNT (EPCT);
000110  6  2231                        CASEST:         PROCESSCASE;
000113  6  2232                        RECDEC:         PROCESSRECORD;
000118  6  2233                        LPAR:           PROCESSENUMTYPE;
000121  6  2234                        BLNKS:          NEWLINE := FALSE;
000123  6  2235                        OTHERWISE;
000152  6  2236                        END;
000152  5  2237                END;
000153  4  2238            END;
000154  3  2239
000154  3  2240  VARDEC:   (* COUNT THE VARIABLES AND ENTER THEM ON TO THE LIST OF
000154  3  2241               DECLARED VARIABLES *)
000154  3  2242            BEGIN
000154  4  2243            STILLVAR := TRUE;
000156  4  2244
000156  4  2245            IF  NOT PARADEC  THEN  (* IF NOT WITHIN A PARAMETER DECL *)
000160  4  2246
000160  4  2247            WHILE  STILLVAR  DO
000162  4  2248                   BEGIN
000162  5  2249                   SCANNER;
000163  5  2250                   CASE  ACTION  OF
000165  6  2251                         PROCS,
000165  6  2252                         LBLDEC.CONDEC.
000165  6  2253                         TYPDEC.VARDEC.
000165  6  2254                         VALDEC.FINDBEG: BEGIN  (* FIND THE END OF THE DECL *)
000165  7  2255                                         STILLVAR := FALSE;
000167  7  2256                                         YES := FALSE;
000170  7  2257                                         END;
000171  6  2258                         COLON:          WHILE  ACTION <> SEMI  DO
000174  6  2259                                                BEGIN  (* SKIP TO THE SEMICOLON *)
000174  7  2260                                                SCANNER;
000175  7  2261                                                CASE  ACTION  OF
000177  8  2262                                                      BLNKS:       NEWLINE := FALSE;
000201  8  2263                                                      LPAR:        PROCESSENUMTYPE;
000204  8  2264                                                      RECDEC:      PROCESSRECORD;
000207  8  2265                                                      CASEST:      PROCESSCASE;
000212  8  2266                                                      OTHERWISE;
000234  8  2267                                                      END;
000234  7  2268                                                END;
000236  6  2269                         BLNKS:          NEWLINE := FALSE;
000240  6  2270                         SEMI,
000240  6  2271                         COMNT,
000240  6  2272                         COMMA::
000241  6  2273                         ABT:            ABORT;
000243  6  2274                         OTHERWISE       BEGIN  (* FOUND A VARIABLE NAME *)
000273  7  2275                                         COUNT (UNOPN);
000278  7  2276                                         COUNT (EPVAR);
000301  7  2277                                         IF  KEYWORD
000301  7  2278                                         THEN  IF  ISADELIMITER
000303  7  2279                                               THEN  ABORT
000304  7  2280                                               ELSE  REDEF;
```

```
000307  7  2281                                    DECLARE:
000310  7  2282                                    END:
000310  6  2283                 END;
000310  5  2284              END
000310  4  2285
000310  4  2286          ELSE  (* IF WITHIN A PARAMETER DECL *)
000312  4  2287
000312  4  2288          WHILE  STILLVAR  DO
000314  4  2289                 BEGIN
000314  5  2290                 SCANNER;
000315  5  2291                 CASE  ACTION  OF
000317  6  2292                       ABT:       ABORT;
000321  6  2293                       BLNKS:     NEWLINE := FALSE;
000323  6  2294                       COMMIT;
000324  6  2295                       SEMI:      STILLVAR := FALSE;  (* REACHED END OF CURRENT ITEM *)
000326  6  2296                       PROCS:     ABORT;
000330  6  2297                       COMMA:;
000331  6  2298                       COLON:     BEGIN  (* GO TO THE END OF THE CURRENT ITEM *)
000331  7  2299                                  WHILE  (ACTION <> SEMI) AND (ACTION <> RPAR)  DO
000336  7  2300                                         BEGIN
000336  8  2301                                         SCANNER;
000337  8  2302                                         CASE  ACTION  OF
000341  9  2303                                               BLNKS:       NEWLINE := FALSE;
000343  9  2304                                               LPAR:        PROCESSENUMTYPE;
000346  9  2305                                               RECDEC:      PROCESSRECORD;
000351  9  2306                                               CASEST:      PROCESSCASE;
000354  9  2307                                               RPAR:        BEGIN  (* END OF THE PARAMETER DECL *)
000354 10  2308                                                            STILLVAR := FALSE;
000356 10  2309                                                            YES := FALSE;
000357 10  2310                                                            END;
000360  9  2311                                               OTHERWISE;
000402  9  2312                                               END;
000402  8  2313                                         END;
000403  7  2314                                  WHILE  STILLVAR  DO
000405  7  2315                                         BEGIN  (* GO TO THE NEXT ITEM *)
000405  8  2316                                         SCANNER;
000406  8  2317                                         CASE  ACTION  OF
000410  9  2318                                               SEMI:;
000411  9  2319                                               COMMA:;
000412  9  2320                                               BLNKS:       NEWLINE := FALSE;
000414  9  2321                                               OTHERWISE    BEGIN
000423 10  2322                                                            STILLVAR := FALSE;
000425 10  2323                                                            YES := FALSE;
000428 10  2324                                                            CASE  ACTION  OF
000430 11  2325                                                                  VARDEC:  (* NEXT VAR PARAMETER *)
000430 11  2326                                                                  RPAR:;   (* END OF PARAMETER DECL *)
000431 11  2327                                                                  PROCS:       BEGIN  (* PROCEDURE PARAMETER *)
000431 12  2328                                                                               COUNT (VALPAR);
000434 12  2329                                                                               END;
000435 11  2330                                                                  OTHERWISE    ACTION := OPND;  (* FOUND VAR PARA
000451 11  2331                                                                               END;
000451 10  2332                                                            END;
000451  9  2333                                               END;
000451  8  2334                                         END;
000452  7  2335                       OTHERWISE  BEGIN  (* FOUND VAR PARAMETER *)
000453  8  2336                                  IF  KEYWORD
000501  7  2337
```

```
000501  7  2338                                    THEN  IF  ISADELIMITER
000503  7  2339                                              THEN  ABORT
000504  7  2340                                              ELSE  REDEF;
000507  7  2341                                    DECLARE;
000510  7  2342                                    COUNT (VARPA);
000513  7  2343                                    COUNT (EPVAR);
000516  7  2344                                    COUNT (UPIOPN);
000521  7  2345                                    END;
000521  6  2346                          END;
000521  5  2347                    END;
000522  4  2348              END;
000523  3  2349
000523  3  2350  VALDEC:    (* IGNORE THE VALUE DECLARATION *)
000523  3  2351              BEGIN
000523  4  2352              STILLVAL := TRUE;
000525  4  2353              WHILE  STILLVAL  DO
000527  4  2354                    BEGIN  (* LOOK FOR THE END OF THE VALUE DECL *)
000527  5  2355                    SCANNER;
000530  5  2356                    CASE  ACTION  OF
000532  6  2357                          PROCS,
000532  6  2358                          LBLDEC,CONDEC,
000532  6  2359                          TYPDEC,VARDEC,
000532  6  2360                          VALDEC,FINDBEG: BEGIN
000532  7  2361                                          STILLVAL := FALSE;
000534  7  2362                                          YES := FALSE;
000535  7  2363                                          END;
000536  6  2364                          BLNKS:          NEWLINE := FALSE;
000540  6  2365                          OTHERWISE:
000560  6  2366                          END;
000560  5  2367                    END;
000561  4  2368              END;
000562  3  2369
000562  3  2370  PROG:       (* ENTER THE CCID INTO THE CCID ARRAY
000562  3  2371                 AND INITIALIZE STARTPOS *)
000562  3  2372              BEGIN
000562  4  2373              STARTPOS := 1;
000564  4  2374              WHILE  LINE[STARTPOS] = ' '  DO  (* FIND THE INDENFUNC REFERENCE *)
000571  4  2375                    STARTPOS := STARTPOS + 1;
000573  4  2376              NESTLEVEL := 1;
000575  4  2377              (* INITIALIZE LISTS *)
000575  4  2378              HEADTEMP[NESTLEVEL] :=  NIL;
000600  4  2379              HEADREDEF[NESTLEVEL] := NIL;
000603  4  2380              DECLIST[NESTLEVEL] :=   NIL;
000606  4  2381              WHILE  ACTION <> OPND  DO
000611  4  2382                    BEGIN  (* GET THE CCID *)
000611  5  2383                    SCANNER;
000612  5  2384                    CASE  ACTION  OF
000614  6  2385                          BLNKS:          NEWLINE := FALSE;
000616  6  2386                          OTHERWISE:
000623  6  2387                          END;
000623  5  2388                    END;
000624  4  2389              FOR I := 1 TO CCIDLNGTH DO  (* THE CCID OCCUPIES THE FIRST FOUR CHARS *)
000626  4  2390                 CCID[MODULE,I] := IDENBUFF[I];
000653  4  2391              END;
000654  3  2392
000654  3  2393  PROCS:      (* PROCESS A PROCEDURE DECLARATION AND ADD PARAMETERS TO THE
000654  3  2394                 DECLIST OF THE PROPER NESTLEVEL *)
```

```
000654  3  2395            BEGIN
000654  4  2396            IF  NOT PRODECL  (* IF NOT A PARAMETER *)
000654  4  2397            THEN  BEGIN
000656  5  2398                  SCANNER;
000657  5  2399                  WHILE  ACTION = BLNKS  DO
000662  5  2400                         BEGIN  (* SKIP BLANKS *)
000662  6  2401                         NEWLINE := FALSE;
000663  6  2402                         SCANNER;
000664  6  2403                         END;
000665  5  2404                  IF  KEYWORD
000665  5  2405                  THEN  IF  ISADELIMITER
000667  5  2406                        THEN  ABORT
000670  5  2407                        ELSE  REDEF;
000673  5  2408                  NEW (PTRNEWREC);
000675  5  2409                  WITH  PTRNEWREC^  DO
000702  5  2410                        BEGIN  (* INSERT PROCEDURE NAME INTO SYMTBL *)
000702  6  2411                        FOR I := 1 TO ENDIDEN DO
000705  6  2412                            STRING[I] := IDENBUFF[I];
000725  6  2413                        FOR I := ENDIDEN + 1 TO 10 DO
000727  6  2414                            STRING[I] := ' ';
000743  6  2415                        LNGTH := ENDIDEN;
000745  6  2416                        OP := TRUE;
000748  6  2417                        USED := FALSE;
000747  6  2418                        NEXTSYM := NIL;
000750  6  2419                        LASTSYM := NIL;
000752  6  2420                        NEXTTMP := NIL;
000753  6  2421                        TOK := FUNCS;
000755  6  2422                        END;
000755  5  2423                  INSERTTEMP (NESTLEVEL);
000757  5  2424                  NESTLEVEL := NESTLEVEL + 1;
000763  5  2425                  (* INITIALIZE LISTS *)
000763  5  2426                  DECLIST[NESTLEVEL] :=  NIL;
000766  5  2427                  HEADTEMP[NESTLEVEL] :=  NIL;
000770  5  2428                  HEADREDEF[NESTLEVEL] := NIL;
000773  5  2429                  STARTPROC[NESTLEVEL] := NUMEEG;
000776  5  2430                  PRODECL := TRUE;
001000  5  2431                  COUNT (EPPRO);
001003  5  2432                  END
001003  4  2433            ELSE  BEGIN  (* IF THE PROCEDURE IS A PARAMETER *)
001004  5  2434                  SCANNER;
001005  5  2435                  WHILE  ACTION = BLNKS  DO
001010  5  2436                         BEGIN  (* SKIP BLANKS *)
001010  6  2437                         NEWLINE := FALSE;
001011  6  2438                         SCANNER;
001012  6  2439                         END;
001013  5  2440                  IF  KEYWORD
001013  5  2441                  THEN  IF  ISADELIMITER
001015  5  2442                        THEN  ABORT
001016  5  2443                        ELSE  REDEF;
001021  5  2444                  NEW (PTRNEWREC);
001023  5  2445                  WITH  PTRNEWREC^  DO
001030  5  2446                        BEGIN  (* INSERT PROCEDURE NAME INTO SYMTBL FOR LIFE OF PROCEDURE *)
001030  6  2447                        FOR I := 1 TO ENDIDEN DO
001033  6  2448                            STRING[I] := IDENBUFF[I];
001053  6  2449                        LNGTH := ENDIDEN;
001055  6  2450                        OP := TRUE;
001056  6  2451                        USED := FALSE;
```

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001057  6  2452                        NEXTSYM := NIL;
001060  6  2453                        LASTSYM := NIL;
001062  6  2454                        NEXTIMP := NIL;
001063  6  2455                        TOK := FUNCS;
001065  6  2456                        END;
001065  5  2457                    INSERTTEMP (NESTLEVEL);
001067  5  2458                    STILLVAR := TRUE;
001071  5  2459                    WHILE  STILLVAR  DO
001073  5  2460                            BEGIN
001073  6  2461                            SCANNER;
001074  6  2462                            CASE  ACTION  OF
001076  7  2463                                  SEMI,
001076  7  2464                                  COMMA:;
001077  7  2465                                  COLON:      WHILE  (ACTION <> SEMI) AND (ACTION <> RPAR)  DO
001104  7  2466                                                BEGIN  (* GO TO END OF CURRENT ITEM *)
001104  8  2467                                                SCANNER;
001105  8  2468                                                CASE  ACTION  OF
001107  9  2469                                                      BLNKS:        NEWLINE := FALSE;
001111  9  2470                                                      RPAR:         BEGIN  (* END OF PARAMETER DECL *)
001111 10  2471                                                                   STILLVAR := FALSE;
001113 10  2472                                                                   YES := FALSE;
001114 10  2473                                                                   END;
001115  9  2474                                                      OTHERWISE:
001127  9  2475                                                      END;
001127  8  2476                                                END;
001131  7  2477                                  BLNKS:      NEWLINE := FALSE;
001133  7  2478                                  LPAR:       BEGIN  (* SKIP TO END OF NESTED PARAMETER DECL *)
001133  8  2479                                              LPARCOUNT := 1;
001135  8  2480                                              WHILE  LPARCOUNT > 0  DO
001137  8  2481                                                     BEGIN
001137  9  2482                                                     SCANNER;
001140  9  2483                                                     CASE  ACTION  OF
001142 10  2484                                                           BLNKS:     NEWLINE := FALSE;
001144 10  2485                                                           LPAR:      LPARCOUNT := LPARCOUNT + 1;
001147 10  2486                                                           RPAR:      LPARCOUNT := LPARCOUNT - 1;
001152 10  2487                                                           OTHERWISE:
001165 10  2488                                                           END;
001165  9  2489                                                     END;
001166  8  2490                                              END;
001167  7  2491                                  OTHERWISE   BEGIN  (* FIND BEGINNING OF NEXT ITEM *)
001211  8  2492                                              STILLVAR := FALSE;
001213  8  2493                                              YES := FALSE;
001214  8  2494                                              CASE  ACTION  OF
001216  9  2495                                                    VARDEC,   (* FOUND A VAR PARAMETER *)
001216  9  2496                                                    RPAR:;    (* END OF THE PARAMETER DECL *)
001217  9  2497                                                    PROCS:       BEGIN  (* FOUND A PROCEDURE PARAMETER *)
001217 10  2498                                                                 COUNT (VALPAR);
001222 10  2499                                                                 END;
001223  9  2500                                                    OTHERWISE   ACTION := OPND;  (* FOUND A VALUE PARAMETER *)
001237  9  2501                                                    END;
001237  8  2502                                              END;
001237  7  2503                                  END;
001237  6  2504                            END;
001240  5  2505                    END;
001240  4  2506                END;
001241  3  2507
001241  3  2508  END:      (* TERMINATE PROCEDURE DECL *)
```

```
001241  3  2509            BEGIN
001241  4  2510            FWDDEC := TRUE;
001243  4  2511            AMTFWDDEC := AMTFWDDEC + 1;
001245  4  2512            PROCANDFUNC := PROCANDFUNC - 1;
001246  4  2513            EXITPROCEDURE:
001247  4  2514            END;
001250  3  2515
001250  3  2516  CASEST:   (* INDICATE TO FINDEND THERE IS A CASE STMT.
001250  3  2517               REMOVE THE ARGUMENT FROM THE DECLIST  *)
001250  3  2518            BEGIN
001250  4  2519            NUMCASE := NUMCASE + 1;
001252  4  2520            SCANNER;
001253  4  2521            WHILE  ACTION = BLNKS  DO
001256  4  2522                   BEGIN  (* SKIP BLANKS *)
001256  5  2523                   NEWLINE := FALSE;
001257  5  2524                   SCANNER;
001260  5  2525                   END;
001261  4  2526            OPNUSED;
001262  4  2527            COUNT (EPOPN);
001265  4  2528            END;
001266  3  2529
001266  3  2530  FINDBEG:  (* INCREMENT NUMBER OF BEGINS *)
001266  3  2531            NUMBEG := NUMBEG + 1;
001271  3  2532
001271  3  2533  FINDEND:  (* DECREMENT NUMBER OF BEGINS; DECREMENT NESTLEVEL IF AT THE
001271  3  2534               END OF A PROCEDURE *)
001271  3  2535            BEGIN
001271  4  2536            IF  NUMCASE = 0
001271  4  2537            THEN  NUMBEG := NUMBEG - 1
001273  4  2538            ELSE  NUMCASE := NUMCASE - 1;
001277  4  2539            IF  STARTPROC[NESTLEVEL] = NUMBEG  (* TERMINATE PROCEDURE IF AT END *)
001302  4  2540            THEN  EXITPROCEDURE;
001305  4  2541            ENDFLAG := TRUE;
001307  4  2542            END;
001310  3  2543
001310  3  2544  LPAR:     (* IF IN A PROCEDURE DECL NOTIFY DRIVER *)
001310  3  2545            IF  PRODECL
001310  3  2546            THEN  BEGIN  (* IN A PROCEDURE DECLARATION *)
001312  4  2547                  PARADEC := TRUE;
001313  4  2548                  SCANNER;
001314  4  2549                  WHILE  ACTION = BLNKS  DO
001317  4  2550                         BEGIN  (* SKIP BLANKS *)
001317  5  2551                         NEWLINE := FALSE;
001320  5  2552                         SCANNER;
001321  5  2553                         END;
001322  4  2554                  CASE  ACTION  OF
001323  5  2555                        VARDEC,  (* FOUND VAR PARAMETER *)
001323  5  2556                        SEMI:;   (* FOUND NO PARAMETER *)
001324  5  2557                        RPAR,    (* FOUND END OF DECL *)
001324  5  2558                        COMNT,
001324  5  2559                        PROCS:       BEGIN  (* FOUND PROCEDURE PARAMETER *)
001324  6  2560                                    COUNT (VALPAT);
001330  6  2561                                    END;
001331  5  2562                        OTHERWISE    ACTION := OPND;  (* FOUND VAL PARAMETER *)
001351  5  2563                        END;
001351  4  2564                  YES := FALSE;  (* DO NOT SCAN AGAIN- LET DRIVER TAKE APPROPRIATE ACTION *)
001353  4  2565                  END;
```

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001354  3  2586
001354  3  2587  RPAR:     (* IF IN A PROCEDURE, NOTIFY DRIVER OF ITS TERMINATION *)
001354  3  2588            IF  PRODECL
001354  3  2589            THEN  PARADEC := FALSE;
001360  3  2570
001360  3  2571  FORST:    (* INCREMENT FOR STMT COUNT *)
001360  3  2572            COUNT (FORCT);
001364  3  2573
001364  3  2574  GOTOST:   (* INCREMENT GOTO STMT COUNT *)
001364  3  2575            COUNT (GOCNT);
001370  3  2576
001370  3  2577  INST:     (* NOTIFY DRIVER THAT YOU ARE IN AN IN STMT *)
001370  3  2578            ININ := TRUE;
001372  3  2579
001372  3  2580  REPST:    (* INCREMENT REPEAT STMT COUNT *)
001372  3  2581            COUNT (REPCT);
001376  3  2582
001376  3  2583  WHIST:    (* INCREMENT WHILE STMT COUNT *)
001376  3  2584            COUNT (WHICT);
001402  3  2585
001402  3  2586  COMNT:    (* INCREMENT LINESOFCOMMENT *)
001402  3  2587            IF  NOT PRODECL
001402  3  2588            THEN  COUNT (EPCOM);
001411  3  2589
001411  3  2590  LBRAC:    (* IF IN AN IN STMT, LBRAC IS NOT COUNTED AS AN OPERATOR *)
001411  3  2591            BEGIN
001411  4  2592            IF  ININ
001411  4  2593            THEN  OPERATORS := OPERATORS - 1;
001415  4  2594            ININ := FALSE;
001417  4  2595            END;
001420  3  2596
001420  3  2597  SEMI:     (* TERMINATE PROCEDURE DECLARATIONS AND CHECK TO SEE IF MORE
001420  3  2598               THAN ONE STMT IS ON THE SAME LINE *)
001420  3  2599            BEGIN
001420  4  2600            IF  (NOT PARADEC) AND PRODECL
001422  4  2601            THEN  PRODECL := FALSE;
001424  4  2602            IF  SAMELINE
001424  4  2603            THEN  COUNT (EPMOL);
001431  4  2604            IF  NOT PARADEC
001431  4  2605            THEN  SAMELINE := TRUE;
001435  4  2606            ENDFLAG := FALSE;
001[illegible]  4  2607            END;
001440  3  2608
001440  3  2609  OPND:     (* INCREMENT THE APPROPRIATE OPERAND RELATED COUNTS AND ADD
001[illegible]  3  2610               APPROPRIATE VARIABLES TO THE DECLIST *)
001443  3  2611            BEGIN
001440  4  2612            IF  PARADEC
001440  4  2613            THEN  BEGIN  (* IF WITHIN A PARAMETER DECL *)
0014[illegible]  5  2614                  IF  KEYWORD
0014[illegible]  5  2615                  THEN  IF  ISADELIMITER
0014[illegible]  5  2616                        THEN  ABORT
001447  5  2617                        ELSE  REDEF;
0014[illegible]  5  2618                  COUNT (VALPA);
0014[illegible]  5  2619                  COUNT (EPVAR);
0014[illegible]  5  2620                  COUNT (UNOPN);
0014[illegible]  5  2621                  DECLARE;
0014[illegible]  5  2622                  SIMPLVAL := TRUE
```

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001484  5  2623                WHILE  STILLVAL  DO
001486  5  2624                       BEGIN  (* FIND NEXT ITEM *)
001486  6  2625                       SCANNER;
001467  6  2626                       CASE  ACTION  OF
001471  7  2627                             BLNKS:     NEWLINE := FALSE;
001473  7  2628                             COMNT,
001473  7  2629                             COMMA::
001474  7  2630                             PROCS:     BEGIN  (* FOUND PROCEDURE PARAMETER *)
001474  8  2631                                        COUNT (UNOPS);
001477  8  2632                                        COUNT (EPOPS);
001502  8  2633                                        COUNT (VALPA);
001505  8  2634                                        STILLVAL := FALSE;
001507  8  2635                                        END;
001510  7  2636                             COLON:     BEGIN
001510  8  2637                                        WHILE  (ACTION <> SEMI) AND (ACTION <> RPAR)  DO
001515  8  2638                                               BEGIN  (* GO TO END OF CURRENT ITEM *)
001515  9  2639                                               SCANNER;
001516  9  2640                                               CASE  ACTION  OF
001520 10  2641                                                     BLNKS:      NEWLINE := FALSE;
001522 10  2642                                                     RPAR:       BEGIN  (* END OF PARAMETER DECL *)
001522 11  2643                                                                 STILLVAL := FALSE;
001524 11  2644                                                                 YES := FALSE;
001525 11  2645                                                                 END;
001526 10  2646                                                     CASEST:     PROCESSCASE;
001531 10  2647                                                     OTHERWISE;
001546 10  2648                                                     END;
001546  9  2649                                               END;
001547  8  2650                                        WHILE  STILLVAL  DO
001551  8  2651                                               BEGIN  (* GET NEXT ITEM *)
001551  9  2652                                               SCANNER;
001552  9  2653                                               CASE  ACTION  OF
001554 10  2654                                                     SEMI,
001554 10  2655                                                     COMNT::
001555 10  2656                                                     BLNKS:      NEWLINE := FALSE;
001557 10  2657                                                     OTHERWISE  BEGIN
001566 11  2658                                                                STILLVAL := FALSE;
001570 11  2659                                                                YES := FALSE;
001571 11  2660                                                                CASE  ACTION  OF
001573 12  2661                                                                      VARDEC,  (* FIND VAR PARAMETER *)
001573 12  2662                                                                      RPAR::   (* END OF PARAMETER DECL *)
001574 12  2663                                                                      PROCS:      BEGIN  (* FIND PROCEDURE PARA *)
001574 13  2664                                                                                  COUNT (VALPA);
001577 13  2665                                                                                  END;
001600 12  2666                                                                      OTHERWISE  ACTION := OPND;  (* FIND VAL PARA
001614 12  2667                                                                      END;
001614 11  2668                                                           END;
001614 10  2669                                                     END;
001614  9  2670                                               END;
001615  8  2671                                        END;
001616  7  2672                             OTHERWISE  BEGIN  (* FOUND ANOTHER VAL PARAMETER *)
001644  8  2673                                        IF  KEYWORD
001644  8  2674                                        THEN  IF  ISADELIMITER
001646  8  2675                                              THEN  ABORT
001647  8  2676                                              ELSE  REDEF;
001652  8  2677                                        DECLARE;
001653  8  2678                                        COUNT (VALPA);
001656  8  2679                                        COUNT (EPVAR);
```

```
001661  0  2680                                        COUNT (UNOPN);
001664  0  2681                                        END;
001664  7  2682                                  END;
001664  6  2683                            END;
001665  5  2684                      END
001665  4  2685                ELSE  BEGIN  (* NOT WITHIN A PARAMETER DECL *)
001666  5  2686                      COUNT (EPOPN);
001671  5  2687                      OPNUSED;
001672  5  2688                      END;
001672  4  2689                END;
001673  3  2690
001673  3  2691  NMBR:       (* ADD NUMBER TO THE UNIQUE NUMBER LIST AND INCREMENT OPERAND COUNT *)
001673  3  2692                BEGIN
001673  4  2693                COUNT (EPOPN);
001676  4  2694                NEW (PTRNEWREC);  (* INSERT NUMBERS INTO THE NUMBER LIST *)
001700  4  2695                IF  HEADNMBR = NIL
001700  4  2696                THEN  HEADNMBR := PTRNEWREC
001703  4  2697                ELSE  BEGIN
001705  5  2698                      PTR := HEADNMBR;
001707  5  2699                      WHILE  PTR <> NIL  DO
001712  5  2700                            BEGIN  (* IS IT IN THE NUMBER LIST ALREADY *)
001712  6  2701                            IF  ENDIDEN = PTR^.LNGTH
001716  6  2702                            THEN  WITH PTR^  DO
001724  6  2703                                  BEGIN
001724  7  2704                                  UNPACK (STRING.BUFF,1);
001730  7  2705                                  FOR I := 1 TO ENDIDEN DO
001732  7  2706                                      IF  IDENBUFF[I] <> BUFF[I]
001741  7  2707                                      THEN  GOTO 3;
001751  7  2708                                  DISPOSE (PTRNEWREC);
001753  7  2709                                  GOTO 4;
001754  7  2710                                  END;
001754  6  2711                            3: AUXPTR := PTR;
001756  6  2712                            PTR := PTR^.NEXTSYM;
001763  6  2713                            END;
001764  5  2714                      AUXPTR^.NEXTSYM := PTRNEWREC;
001772  5  2715                      END;
001772  4  2716                WITH  PTRNEWREC^  DO
001777  4  2717                      BEGIN  (* IT IS NOT THERE, SO INSERT IT *)
001777  5  2718                      FOR I := 1 TO ENDIDEN DO
002002  5  2719                          STRING[I] := IDENBUFF[I];
002022  5  2720                      LNGTH := ENDIDEN;
002024  5  2721                      NEXTSYM := NIL;
002025  5  2722                      END;
002025  4  2723                4: END;
002026  3  2724
002026  3  2725  BLNKS:       (* RUN EITHER THE INDENTATION FUNCTION OR INCREMENT CODE LINES
002026  3  2726                   COUNTER *)
002026  3  2727                BEGIN
002026  4  2728                IF  NEWLINE
002026  4  2729                THEN  IF  INDEX <> ENDLINE
002030  4  2730                      THEN  COUNT (INDNF);  (* COMPUTE INDENFUNC *)
002035  4  2731                NEWLINE := FALSE;
002037  4  2732                END;
002040  3  2733
002040  3  2734  ASSIGN:     (* DECREMENT   OPERATORS
002040  3  2735                            OPERANDS
002040  3  2736                            CODELINES *)
```

```
002040  3  2737            BEGIN
002040  4  2738            OPERATORS := OPERATORS - 1;
002042  4  2739            OPERANDS  := OPERANDS - 2;
002044  4  2740            CODELINES := CODELINES - 1;
002046  4  2741            END;
002047  3  2742
002047  3  2743  EOLNM,
002047  3  2744  EOLNSM,
002047  3  2745  EOFM,
002047  3  2746  EOFSM:     (* IGNORE PARAMETER *)
002047  3  2747            BEGIN
002047  4  2748            SCANNER;
002050  4  2749            WHILE  ACTION = BLNKS  DO
002053  4  2750                   BEGIN  (* SKIP BLANKS *)
002053  5  2751                   NEWLINE := FALSE;
002054  5  2752                   SCANNER;
002055  5  2753                   END;
002056  4  2754            IF  ACTION = LPAR
002058  4  2755            THEN  WHILE  ACTION <> RPAR  DO
002063  4  2756                         SCANNER  (* SKIP FILE NAME *)
002063  4  2757            ELSE  YES := FALSE;
002070  4  2758            END;
002071  3  2759
002071  3  2760  TERM:     (* TERMINATE CURRENT PROGRAM *)
002071  3  2761            IF  ENDFLAG
002071  3  2762            THEN  BEGIN
002073  4  2763                  MODFINI;
002074  4  2764                  MODINIT;
002075  4  2765                  END;
002076  3  2766
002076  3  2767  ENDLIST:  (* TERMINATE ACCUSE *)
002076  3  2768            BEGIN
002076  4  2769            KEY := PARACOUNT;  (* INSERT KEY VALUE *)
002100  4  2770            MODULE := MODULE - 1;
002103  4  2771            SORTPROGNOSIS (1,MODULE);  (* SORT ON THE KEY *)
002105  4  2772            OUTPUTPROGNOSIS;           (* PRINT THE RESULTS *)
002106  4  2773            (* UP TO SEVEN ADDITIONAL SORTS CAN BE REQUESTED *)
002106  4  2774            MORESORTS (18,19,16,17,2,6,ADD(12,ADD(13,14)));
002131  4  2775            PRINTFREQ;
002132  4  2776            GOTO  1;
002134  4  2777            END;
002135  3  2778
002135  3  2779  ABT:      (* ABORT THE CURRENT PROGRAM *)
002135  3  2780            ABORT;
002137  3  2781
002137  3  2782  FUNCS,
002137  3  2783  RECDEC,
002137  3  2784  TOST,
002137  3  2785  WITHST,
002137  3  2786  RBRAC,
002137  3  2787  EQUAL,
002137  3  2788  COLON,
002137  3  2789  COMMA,
002137  3  2790  FINDOFF;
002140  3  2791  DUMMY:    ENDFLAG := FALSE;
002142  3  2792
002142  3  2793  END;  (* CASE ACTION OF *)
```

```
002173  2  2794
002173  2  2795  END;  (* WHILE *)
002174  1  2796
002174  1  2797  END;  (* DRIVER *)
002222  0  2798
002222  0  2799
002222  0  2800
002222  0  2801  BEGIN (* MAIN PROGRAM *)
002222  1  2802  ACCUSEINIT;
000025  1  2803  SYMINIT;
000026  1  2804  SCANINIT;
000027  1  2805  DRIVER;
000030  1  2806  1:
000030  1  2807  END.  (* MAIN PROGRAM *)

          COMPILER-ESTIMATED "W" OPTION = 0661358.
```

APPENDIX I

ACCUSE USER MANUAL

1. PURPOSE

ACCUSE PROCESSES A GROUP OF PROGRAMS AND MATCHES ANY PAIRS OF PROGRAMS THAT ARE SUFFICIENTLY SIMILAR SUCH THAT PLAGIARISM IS A POSSIBILITY. ACCUSE, HOWEVER, MAKES NO JUDGEMENT AS TO THE QUESTION OF PLAGIARISM. FINAL JUDGEMENT IS LEFT TO THE USER.

2. BACKGROUND

AS NOTED IN RECENT LITERATURE, PLAGIARISM HAS BECOME A PROBLEM IN INTRODUCTORY COMPUTER SCIENCE COURSES. ONE SOLUTION TO THIS PROBLEM HAS BEEN THE DEVELOPMENT OF A PROGRAM AT PURDUE UNIVERSITY TO QUANTIFY THE SAMENESS OF FORTRAN PROGRAMS. THIS PROGRAM UTILIZES SOFTWARE SCIENCE MEASURES OF LENGTH TO MEASURE SIMILARITY OF PROGRAMS. SOFTWARE SCIENCE WAS FOUNDED IN 1972 BY M. HALSTEAD. HE SUGGESTED FOUR BASIC PARAMETERS THAT ARE USEFUL MEASURES OF PROGRAM CHARACTERISTICS.

ACCUSE ATTEMPTS TO GO BEYOND THESE FOUR PARAMETERS IN THE BELIEF THAT ADDITIONAL PARAMETERS ARE AVAILABLE TO ESTABLISH DISSIMILARITY OF TWO OR MORE PROGRAMS. IT USES SEVEN PARAMETERS AND VARIOUS COUNTING HEURISTICS THAT RESULT IN THE COMPUTATION OF A CORRELATION NUMBER THAT IS USED TO DETERMINE THE SIMILARITY OF TWO PROGRAMS. ACCUSE MEASURES 20 PARAMETERS, WITH THE SEVEN THAT COMPRISE THE CORRELATION NUMBER SELECTED BY TESTING.

ACCUSE IS AN INFANT, AND SUGGESTIONS ARE INVITED FROM USERS AS TO ITS IMPROVEMENT.

3. GENERAL COMMENTS

ACCUSE WAS DESIGNED TO BE INEXPENSIVE: IT PROCESSES OVER 170 LINES PER SECOND. THE RESULT IS A COMPROMISE BETWEEN SPEED AND COMPREHENSIVE ANALYSIS.

CONSEQUENTLY, ACCUSE WILL NOT DISCOVER CHANGES MADE BY THE SOPHISTICATED PLAGIARIST. THIS IS RATIONALIZED WITH THE ASSUMPTION THAT THE STUDENT INTELLIGENT ENOUGH TO PLAGIARIZE WITH SOPHISTICATION HAS NO NEED TO PLAGIARIZE. HOPEFULLY, THOUGH, ACCUSE IS NOT SO SIMPLE-MINDED THAT IT IS EASY TO BEAT. IT IS MEANT TO MAKE PLAGIARISM WITHOUT DETECTION DIFFICULT TO ACHIEVE, AND IT IS MEANT TO DO THIS IN SUCH A WAY THAT ITS REPEATED USE DOES NOT COMPROMISE ITS HEURISTICS.

ACCUSE PRESENTLY MEASURES THE FOLLOWING 20 PARAMETERS:

1. TOTAL LINES
2. CODE LINES
3. CODE COMMENT LINES
4. MULTIPLE STATEMENT LINES
5. CONSTANTS AND TYPES
6. VARIABLES DECLARED (AND USED)
7. VARIABLES DECLARED (AND NOT USED)
8. PROCEDURES AND FUNCTIONS
9. VAR PARAMETERS
10. VALUE PARAMETERS
11. PROCEDURE VARIABLES (INCLUDES 9 AND 10)
12. FOR STATEMENTS
13. REPEAT STATEMENTS
14. WHILE STATEMENTS
15. GOTO STATEMENTS
16. UNIQUE OPERATORS
17. UNIQUE OPERANDS
18. TOTAL OPERATORS

19. TOTAL OPERANDS

20. INDENTING FUNCTION

THE SEVEN PARAMETERS USED TO CREATE THE CORRELATION NUMBER ARE:

1. UNIQUE OPERATORS

2. UNIQUE OPERANDS

3. TOTAL OPERATORS

4. TOTAL OPERANDS

5. CODE LINES

6. VARIABLES DECLARED (AND USED)

7. TOTAL CONTROL STATEMENTS

"TOTAL OPERATORS" DOES NOT INCLUDE ASSIGNMENT OPERATORS. ADDITIONALLY, FOR EVERY ASSIGNMENT OPERATOR FOUND, TWO OPERANDS ARE SUBTRACTED FROM "TOTAL OPERANDS," AND "CODE LINES" IS DECREMENTED. THIS WILL (HOPEFULLY) PREVENT ACCUSE FROM BEING MISLED BY INANE ASSIGNMENT STATEMENTS.

SINCE ACCUSE ONLY COUNTS VARIABLES, THE OBVIOUS TACTIC OF CHANGING VARIABLE NAMES MAKES NO DIFFERENCE TO ACCUSE. SINCE PASCAL REQUIRES DECLARATIONS, ACCUSE CAN KEEP TRACK OF VARIABLES DECLARED AND SUBSEQUENTLY USED OR NOT USED. HENCE EXCESS DECLARATIONS ARE AN INEFFECTIVE CHANGE TO A PROGRAM. "CODE LINES" IGNORES BLANK LINES, COMMENT LINES, AND DECLARATIONS. CONSTANTS OF ENUMERATED TYPES AND TAG FIELDS IN CASE CLAUSES OF RECORD DECLARATIONS THAT CONTAIN A DECLARATION ARE CONSIDERED VARIABLES. SINCE THESE CONSTANTS CANNOT BE READ OR WRITTEN, THEIR NON-USE IS NOTABLE.

4. HOW TO RUN ACCUSE

A. HOW PROGRAMS ARE IDENTIFIED

THE TORTYP PROG IN PROCEDURE DRIVER GETS A UNIQUE IDENTIFIER FROM THE FIRST FOUR (CONSTANT CCIDLNGTH) CHARACTERS OF THE PROGRAM NAME. HENCE ANY PROGRAM

BEGINS

PROGRAM AJOBCOUNTCHANGE (INPUT,OUTPUT);

WHERE AJOB IS A UNIQUE IDENTIFIER ISSUED BY THE COMPUTING CENTER. THIS ENABLES EACH PROGRAM TO BE UNIQUELY AND EASILY IDENTIFIED.

B. INPUT OF PROGRAMS

INPUT IS A GROUP OF PROGRAMS INSERTED BACK TO BACK WITH NO SEPARATORS.

BECAUSE ACCUSE IS DESIGNED FOR 200 INPUT PROGRAMS, IT REQUIRES A 200 X 200 MATRIX (ALTHOUGH IT COULD USE A TRIANGULAR MATRIX IF ONE WERE AVAILABLE). THIS IMPLIES, OF COURSE, THE NEED FOR ALOT OF CORE. IF LESS PROGRAMS ARE TO BE INPUT, IT MAY BE ADVANTAGEOUS TO CHANGE THE CONSTANT MAXMODULE TO A SMALLER NUMBER AND THEN RECOMPILE ACCUSE.

C. RESULTS

ACCUSE PRINTS FOUR RESULTS FOR THE USER. THE FIRST IS A DUMP OF EACH INPUT PROGRAM'S CCID AND THE VALUES OF THE 20 PARAMETERS MEASURED BY ACCUSE. THIS DUMP IS SORTED ON THE INDENTING FUNCTION (SEE APPENDIX, "THE INDENTING FUNCTION").

THE SECOND RESULT IS A DUMP OF THE CCIDS AND THEIR RESPECTIVE VALUES OF THE SEVEN PARAMETERS USED TO COMPUTE THE CORRELATION NUMBER; EACH PARAMETER LIST IS SORTED SMALLEST TO LARGEST.

THE THIRD RESULT IS A FREQUENCY DISTRIBUTION GRAPH THAT INDICATES THE NUMBER OF PAIRS OF PROGRAMS WITH LIKE CORRELATION NUMBERS. THE MAX NUMBER OF * PRINTED FOR ANY CORRELATION NUMBER IS 40. THE TUKEY ESTIMATE FOR THE SUSPICION OF PLAGIARISM PRECEDES THE GRAPH.

THE FINAL RESULT IS A LIST OF ALL PAIRS OF PROGRAMS WITH CORRELATION NUMBER >= 28. TWENTY NINE IS CURRENTLY IDENTIFIED AS THE NUMBER THAT IMPLIES PLAGIARISM, WITH 30 THE MAXIMUM CORRELATION NUMBER POSSIBLE.

9. HOW ACCUSE WORKS

ACCUSE ASSUMES ALL PROGRAMS GIVEN TO IT ARE COMPILABLE. IF ACCUSE ABORTS FOR ANY REASON, IT FILLS THE PARAMETER LIST OF THE CURRENT PROGRAM WITH ZEROES. IT THEN FINDS THE FIRST "END" FOLLOWED BY A "." AND RESTARTS PROCESSING. AN ABORT, INCORRECT PROGRAM IDENTIFIERS, AND "WEIRD" COUNTS ARE USUALLY THE RESULT OF SHUFFLED INPUT CARDS.

ACCUSE LOADS ALL OF THE KEYWORDS AND DELIMITERS IN PASCAL (INCLUDING LOCAL IMPLEMENTATION KEYWORDS) INTO A SYMBOL TABLE. ANY ENTITY FOUND BY THE SCANNER IS FIRST TESTED BY PROCEDURE TEST TO SEE IF IT RESIDES IN THE SYMBOL TABLE. IF IT DOES, IT IS NOTED AS A KEYWORD. ELSE IT IS ASSUMED TO BE AN OPERAND.

WHEN A KEYWORD IS REDEFINED AS A VARIABLE BY THE USER, IT IS REMOVED FROM THE SYMBOL TABLE. IT IS REINSERTED INTO THE SYMBOL TABLE WHEN IT REGAINS ITS SYSTEM DEPENDENT DEFINITION.

ALL VARIABLES DECLARED IN A PROGRAM ARE PLACED ON A DECLIST AT THE APPROPRIATE NESTLEVEL AND REMOVED AS THEY ARE USED.

ALL NUMBERS USED IN THE PROGRAM ARE INSERTED ON A NUMLIST (IF NOT ALREADY THERE) AND ARE COUNTED AS UNIQUE OPERANDS.

LABEL AND VALUE DECLARATIONS ARE IGNORED.

THE NUMBER OF TYPES AND CONSTANTS IS COUNTED. THE REST OF THE DECLARATION IS IGNORED.

EXCEPT FOR THE VARIABLES THEMSELVES, VAR DECLARATIONS ARE IGNORED.

IF THE USER DESIRES TO MAKE CHANGES TO ACCUSE, HE SHOULD REFERENCE THE APPENDIX.

APPENDIX J

APPENDIX TO USER MANUAL

APPENDIX TO ACCUSE USER MANUAL

COMPONENTS AND HOW TO CHANGE THEM

A. INSERT/DELETE KEYWORDS FROM THE SYMBOL TABLE

CURRENTLY, 158 KEYWORDS AND DELIMITERS ARE CONTAINED IN THE SYMBOL TABLE. FOR EASE OF MODIFICATION, THE VALUE STATEMENT, AVAILABLE ON OUR COMPILER, IS USED TO INSERT KEYWORDS INTO THE SYMBOL TABLE. IN ADDITION, THE KEYWORDS ARE ARRANGED IN ALPHABETICAL ORDER. WHILE NOT EFFICIENT, AND NOT RECOMMENDED FOR A PRODUCTION MODEL, ALPHABETIZING MAKES FOR EASY CHECKING FOR THE PRESENCE OF A PARTICULAR ENTITY. TRANSLATION OF THE VALUE STATEMENT IS NOT DIFFICULT AND SHOULD NOT AFFECT PORTABILITY.

AN INSERT INTO (DELETE FROM) THE SYMBOL TABLE:

1. CHANGE THE CONSTANT NUMRESWORDS AS APPROPRIATE TO REFLECT THE CHANGE.

2. UNDER THE VALUE STATEMENT INSERT/DELETE THE KEYWORD AS APPROPRIATE, INITIALIZING ALL FIELDS TO THE DESIRED VALUES (SEE TYPE RESSYMBOL).

ACCUSE REMOVES REDEFINED KEYWORDS FROM THE SYMBOL TABLE UNTIL THEY REGAIN THEIR SYSTEM DEFINITION. WHEN REINSERTED INTO THE SYMBOL TABLE, THE KEYWORD IS PLACED AT THE END OF THE APPROPRIATE BUCKET IN THE SYMBOL TABLE. THIS IS DONE IN ANTICIPATION OF AN ORDERING OF KEYWORDS IN THE SYMBOL TABLE AND A DESIRE TO PRESERVE THAT ORDERING (IT IS ASSUMED RESERVED WORDS WILL BE FIRST IN THE BUCKET).

B. THE SCANNER

THE SCANNER IS A MODIFICATION OF THE PASCAL-J SCANNER AVAILABLE TO STUDENTS FOR THEIR WORK HERE AT THE UNIVERSITY OF COLORADO.

C. MAKING A NEW COUNT (OR CHANGING ONE)

ANY CHANGES TO A PARAMETER MUST BE RESOLVED IN PROCEDURE INSERTPROGNOSIS WHERE PARAMETERS ARE INSERTED INTO THE PROGNOSIS ARRAY AND IN PROCEDURE HEADINGS WHERE HEADINGS FOR THE VARIOUS PARAMETERS ARE OUTPUT. IF THE CHANGE INVOLVES ONE OF THE SEVEN PARAMETERS USED TO CALCULATE THE CORRELATION NUMBER, SEE SECTIONS E AND F.

MAKING A NEW COUNT WILL INVOLVE A CHANGE TO THE DRIVER (WHICH PROVIDES THE CODE TO CALCULATE COUNTS) AND TO PROCEDURE COUNT WHERE THE COUNTS ARE MADE. ANY CHANGE TO DRIVER IMPLIES WRITING CODE. IT IS SUGGESTED THAT THE USER CHECK THE PROGRAM TO MAKE SURE HE IS NOT REINVENTING THE WHEEL WHEN HE WRITES HIS CODE.

MAKING A NEW COUNT USUALLY INVOLVES THE CREATION OF A NEW TOKTYP TO BE RECOGNIZED BY DRIVER. THE TOKTYP MUST BE INSERTED INTO THE SCANNER OR INTO THE TOK FIELD (SEE TYPE RESSYMBOL) OF SOME KEYWORD SO THAT THE APPROPRIATE ACTION WILL BE PERFORMED WHEN RECOGNIZED. A NEW COUNTCLASS CAN BE CREATED UNDER THE TYPE STATEMENT AND THE NECESSARY CODE PLACED UNDER THE COUNTCLASS IN PROCEDURE COUNT.

IF THIS NEW COUNT INCREASES THE NUMBER OF PARAMETERS COUNTED, THE CONSTANT PARACOUNT MUST BE INCREMENTED (OR DECREMENTED IF A COUNT IS REMOVED). IN ADDITION, IF THE COUNT IS TO BE MADE FOR EACH INDIVIDUAL MODULE, THE COUNT MUST BE INITIALIZED IN MODINIT. IF THE COUNT WILL PREVAIL OVER THE ENTIRE EXECUTION OF ACCUSE, IT MUST BE INITIALIZED IN ACCUSEINIT.

D. THE INDENTING FUCTION

THE INDENTING FUCTION IS CURRENTLY A SIMPLE ALGORITHM THAT COUNTS THE NUMBER OF LEFT, RIGHT, AND ZERO INDENTATIONS IN THE PROGRAM CODE. A SIGNIFICANT INDEN-

TATION (CONSTANT SIGINDENT) IS CONSIDERED TO BE AN INDENTATION OF AT LEAST THREE CHARACTERS. ONE OR TWO CHARACTER INDENTATION IS CONSIDERED AN ERROR THE STUDENT DID NOT DETECT OR FAILED TO CORRECT.

CURRENTLY, THE CONTENTS OF THE PROGNOSIS ARRAY IS DUMPED SORTED ON THE INDENTING FUNCTION. IT WAS INITIALLY THOUGHT THAT THE INDENTING FUNCTION WOULD PLAY AN IMPORTANT ROLE IN IDENTIFYING PLAGIARISM, BUT THIS DID NOT PROVE TO BE THE CASE. IF ALL PROGRAMS WERE PROCESSED THROUGH SOME SORT OF "PRETTY PRINTER," THE INDENTING FUNCTION COULD BECOME IMPORTANT. THIS ADDITIONAL COST IS CONSIDERED PROHIBITIVE AND IS CONTRARY TO THE INTENT OF ACCUSE BEING INEXPENSIVE TO USE.

E. CHANGING THE PARAMETERS TO COMPUTE THE CORRELATION NUMBER

ENDLIST IN DRIVER CALLS PROCEDURE MORESORTS. IT IS THIS CALL THAT DECIDES WHICH PARAMETERS WILL BE USED IN THE COMPUTATION OF THE CORRELATION NUMBER. PROCEDURE MORESORTS SORTS AND USES THE PARAMETERS SPECIFIED. WHILE MORESORTS REQUIRES SEVEN ARGUMENTS, THE DESIRE TO USE FEWER ARGUMENTS IS EFFECTED BY USING A ZERO FOR ONE OF THE ARGUMENTS. THE FUNCTION ADD IS PROVIDED TO SUM VARIOUS PARAMETERS. A WARNING IS PROVIDED WHEN ADD IS USED TO REMIND THE USER THAT THE HEADING PRINTED IS NOT NECESSARILY THE CORRECT ONE. CURRENTLY, "FOR STMT" IS THE HEADING PRINTED WHEN THE TOTAL NUMBER OF CONTROL STATEMENTS IS OUTPUT FOR THE USER.

IF YOU WANT TO CHANGE THE COMPUTATION OF THE CORRELATION NUMBER, SEE SECTION F.

F. CHANGING THE CORRELATION NUMBER

THE CURRENT CORRELATION NUMBER SCHEME IS ONLY TENTATIVE AND MAY VERY WELL BE SUBJECT TO IMPROVEMENT BY A MORE ELABORATE COMPUTATION SCHEME OR BY SIMPLE

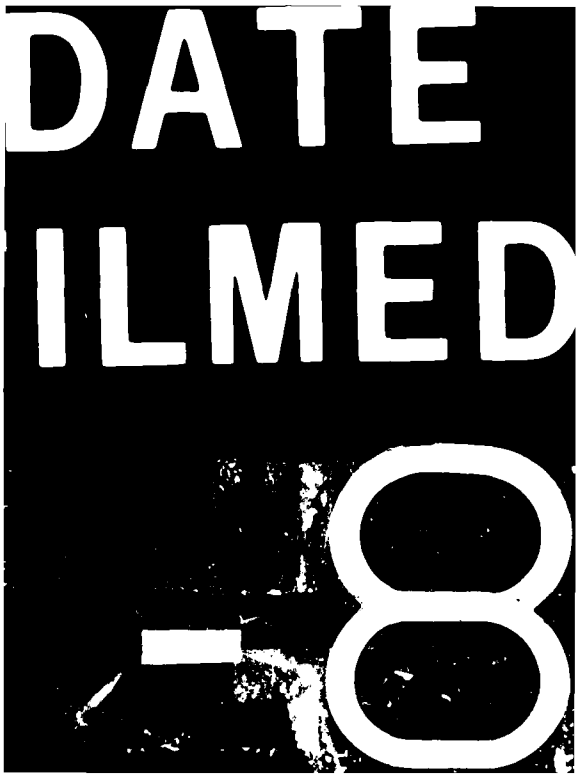
CHANGES TO IMPORTANCE FACTORS (SEE PROCEDURE STATISTICS). THE CURRENT CORRELATION SCHEME IS CONTAINED IN STATISTICS AND PRINTED BY PRINTFREQ. ANY LARGE CHANGES TO THE CORRELATION SCHEME WILL REQUIRE REWRITING THESE TWO PROCEDURES.

THE CURRENT SCHEME INVOLVES COMPUTING AN INCREMENT FOR EACH PAIR OF PROGRAMS BASED ON THE EQUATION

INCREMENT = IMPORTANCE - (PCOUNTA - PCOUNTB)

WHERE PCOUNTA AND PCOUNTB REPRESENT PARAMETER COUNTS AND (PCOUNTA - PCOUNTB) <= WINDOW. IT SHOULD BE OBVIOUS THAT IMPORTANCE MUST BE > WINDOW. THIRTY TWO IS THE MAXIMUM CORRELATION NUMBER.

IF 29 IS THE NUMBER WHERE SUSPICION OF PLAGIARISM OCCURS, NO WINDOW SIZE NEED BE LARGER THAN THREE. HOWEVER, BECAUSE 29 IS ONLY AN OBSERVED PHENOMENON, AND ACCUSE IS STILL IN THE TEST PHASE, THE WINDOW SIZES HAVE BEEN LEFT AS ORIGINALLY IMPLEMENTED.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